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G. H. STOCKBRIDGE, Assoc. Editor Patent Department.
CLARENCE E. STUMP, Business Manager.
WALTER T. HUNT, Advertising Dept.

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Co-Operation Among Telegraphers. NOTE is made elsewhere in our columns of a pleasant meeting held in this city last week, which celebrated the success of the various organizations for relief, self-help and co-operation which have been started and carried on by telegraphers. Our friends of the key deserve hearty congratulations from all on the good work they have done in this field of social effort. They are in the vanguard of one of the greatest movements of our time, and their societies have earned by sound policy and skillful, conservative management all the happy fortune that attends them. Other electric workers might well take them as exemplars in this respect, and probably will.

Electric Lighting by Water Power. OUR illustration on another page, of the Rochester Electric station, demonstates the possibilities to which the Falls of Niagara can be developed. This station, with ovet 1,000 arc lights, is probably the largest electric light station in the world driven by water power; and as the source in this case is a comparatively small one, the enormous power running to waste at Niagara may be approximately estimated. With only a very partial utilization of this great power, and its easy distribution by means of electricity, that vicinity ought to become the greatest manufacturing centre in the world, and it is not improbable that with the carrying out of the intended water way to deflect part of the Falls, this end may be accomplished, without making Niagara any less beautiful.

Proposed Patent Reform. DETAILS will be found on another page as to the measures that have now been presented to Congress in behalf of the National Electric Light Association, calling for specific changes and reforms in the patent system. It will be remembered that at first a sweeping investigation was asked for; now the object of each bill is simple and well defined, and it seems to us that the objects proposed are laudable and fairly within reach. It would undoubtedly be well to facilitate the settlement of patent disputes and suits, and to put an end to the present ambiguity that attaches to Section 4,887 of the Revised Statutes, which, if it really limits the term of American patents, should be forthwith amended. The proposal to increase salaries in the Patent Office also merits support. The examiners and other officials are sadly underpaid, and the department would be higher in efficiency and clearer of suspicion and slander if its employés who do the hard work were better paid.

An Appeal for Postal Telegraphs. THIS week the organized appeal to Congress of the Knights of Labor and other industrial bodies will be made, in favor of government telegraphs. It is asserted that the signatures to the petitions will be nearer to 1,500,000 than the 500,000 first expected, and that the effort receives active advocacy in all quarters. Congress will only do its duty in listening patiently and carefully to all that may be urged, but when it has done this it will not, we think, proceed to invest the country's money in a telegraph business.

The Boston Electric Exchange. THE new departure made in Boston last week in establishing an Electric Exchange, which shall issue licenses to those who carry out electric light construction work, is a step in the right direction, and we trust that the Exchange will be generally approved and supported. At the same time, we would venture the suggestion that in the matter of rules and regulations the National Electric Light Association be consulted, so that uniformity of standard and practice be obtained. At the Detroit meeting of the Association in 1886, it was proposed by one of the editors of this journal that the Association itself take up the subject and devise some plan guaranteeing that only competent men should be permitted to do wiring and similar work, and a license was recommended at that time. It is evident that if different cities or sections of the country have different standards of proficiency and performance, more harm than good will result in some respects. One way to reach the common ideal would be to establish State electric light associations, each effective for local protection of all kinds, adopting the same rules and affiliating with the National Association. There are other ways, of course, of reaching the uniformity so desirable, but this is perhaps as feasible as any.

Maximum Efficiency of Incandescent Lamps. MR. J. W. HOWELL, in his paper read before the American Institute of Electrical Engineers, brings out a most important law, which, if properly applied, ought to determine at once the earning capacity of every incandescent light central station. With the particular lamp upon which he has experimented, Mr. Howell determines that it is working at maximum efficiency when the cost of the lamp is 15 per cent. of the total cost of operation. Hence, with this factor to start on there ought to be no difficulty in the determination of the point to which we have first alluded. This, of course, is independent of what the earning capacity may be of a station which supplies power at the same time, and hence due allowance must be made in such cases. The curves of variation of efficiency at varying candle-powers are very instructive, and Mr. Howell shows up the bad practice of running lamps above their nominal candle-power, under the impression that the cost of operation is thereby reduced. It is evident that the cost of the current alone is reduced, and that the factor of the life of the lamp is being sacrificed; and in the majority of cases this last factor is far greater than the former, so that the total cost of operation is increased, notwithstanding the increased illumination, since the increased illumination is not proportionately paid for. This valuable paper will, no doubt, be read with great interest, not only by all station managers but by the managers of private plants as well.

Posterity as a Supreme Court. WHILE the question of the credit due to some contemporaneous inventors in the field of applied electricity is now hotly debated in pamphlets, newspapers and in the courts, the readers of our literary magazines are being treated to similar weighing of testimony with regard to discoveries and inventions made many years ago. Thus in this month's *Century Magazine* Mr. F. L. Pope, though by no means detracting from the honor due to Professor Morse as the inventor and indefatigable promoter of the universal system of telegraphy, pays a glowing tribute to important services rendered by Alfred Vail in the practical application of Professor Morse's ideas. One reason why Vail's work did not become as prominent as it might have done may be looked for in the statement contained in a letter published in fac-simile, in which Vail states that an agreement between him and Professor Morse prevented him from taking out a patent. The article attributes to Vail the embossing of the characters on tape and the finger telegraph key. Passing to the other article referred to, we find in the *Forum* a decidedly interesting survey of the place which Wm. Gilbert occupies in the annals of electricity. Dr. Park Benjamin shows that notwithstanding the supercilious contempt with which Bacon treats his contemporary Gilbert in the *De Augmentis* and *Novum Organum*, the latter had nevertheless *already applied* the true method of inductive reasoning to the building up of his theory, which demonstrated the difference between the attraction of magnetic bodies and those charged with static electricity; that is, the difference between magnetism and electricity. With these facts before us of polemics relating to times and discoveries long past, who can claim to be able to judge the true place in history of the discoverers and inventors of to-day? Evidently such a judgment, however sincerely sought, has not all the materials at hand necessary for a complete estimate. Time alone can bring these forward, and hence posterity alone must be considered the supreme court which shall finally dispose of these questions. Meanwhile let the facts be given the fullest publicity, until the record is complete.

Doubtful Dynamo Practice. IT would have seemed probable that the experience gained by scores of central electric light stations in this country would constitute some guide to those who are about to undertake similar undertakings abroad, but if we are to believe the accounts which reach us just the reverse of what has here been considered good practice is about to be established there. Only recently it was pointed out and supported by what must be considered indisputable arguments that station lighting, taking into consideration the large fluctuations in the demand, requires sub-division of power in order to obtain the highest economy of working. That this idea is not only prevalent here but also in England is manifest from the discussions which have recently taken place in that country. But the particular instance to which we refer now is the central station about to be constructed at Amsterdam, Holland, which will feed about 5,000 16 c. p. incandescenc lamps. There it is intended to use two compound condensing steam engines of 250 h. p. each and running at 100 revolutions per minute. These are to be coupled direct to the dynamos without any belting or gearing, so that the armature of the machine also will only rotate at 100 revolutions per minute. The advantages which are claimed for this arrangement are the avoidance of numerous small machines and engines and the doing away with the use of all regulators; and besides this the reduction in the number of attendants required and the *more economical* working of slow speed compound engines. We are not informed of the relative cost of labor, fuel and other items which go to make up the cost of the current, but as has often been pointed out, compound engines are quite uneconomical at small loads, and as this is the predominant condition of incandescent light stations at certain hours, it seems hardly probable that the item of fuel expense will be greatly reduced in the proposed station by the employment of the compound engine. It would thus come to be a question of the cost of the fuel as compared with the cost of labor, so that it remains to be seen if it be possible to apply such engines economically.

Why Do We "Convert?" ALTHOUGH much has been already said on the subject of the relative value of alternating and continuous currents in the discussion before the Chicago Electric Club, the battle still continues. Last week Mr. E. P. Warner took up the subject und propounded the query given above. The conclusions arrived at by him are that except under special conditions it would not be advantageous to employ the alternating current. He alluded first to the low efficiency of converters at reduced loads, as shown by the tests of Prof. Ayrton, and then pointed out the barriers which stand in the way of progress regarding the reduction in the cost of the alternating current apparatus. Among these was mentioned the fact recently brought out by Kapp, that converters cannot be worked at a high magnetic induction in the iron without considerable loss from heat due to various causes, and hence to avoid this a comparatively large amount of iron must be used and worked at a lower degree of magnetization. Mr. Warner also pointed out the loss effect due to the reaction of the contiguous wires of the converter coils upon each other. Another rather interesting point which the speaker alluded to was the difference in the losses due to leakage between the wires. Thus he showed that with an E. M. F. of 2,000 volts and an insulating resistance of 1,000 ohms 5.36 electric horse-power would be continually going to waste; while with an E. M. F. of 200 volts, only .053 horse-power was lost in this way. Mr. Warner also objected to the criticism that the arc light current introduced into a building was as dangerous as the alternating, contending that in the former case a comparatively few lamps are placed in series having a potential of about 40 volts each, while with the alternating current the maximum potential is always present. These contentions or arguments were taken up in order by Mr. F. B. Badt, who, speaking on the alternating current side, replied to the criticism of the power wasted by leakage by showing that even with high E. M. F. the same could be greatly reduced by making the insulation sufficient, and that the example chosen by Mr. Warner was especially favorable to the continuous current, and one that was not likely to occur in practice. He also drew attention to the fact that, so far as danger to life is concerned, trouble is to be looked for, not so much from contact with the two sides of a system as from grounds; and hence that, in this sense, an arc wire introduced into a building was just as dangerous as a high-tension alternating current. Besides, there was no necessity for introducing the high tension primaries into houses where they would be liable to be tampered with. Mr. Badt will himself read the next paper on this subject before the club, and will take sides with the advocates o the alternating current.

Accumulators versus Direct Currents for Electric Traction.*

BY W. LINEFF.

On the question of electrical transmission of power as applied to tramways, a rather vexatious problem presented itself. Should continuous conductors or accumulators be used? Electricians and non-professional people interested in tramways were divided into two distinct camps, theoretically hostile to each other. Unfortunately there were as yet no reliable data with reference to the life and cost of renewals of accumulators on tramways; but it was known that they were heavy. Yet sometimes even a rough estimation was of value for practical purposes, and he had recently prepared an estimate when giving his advice on a new tramway that was to be worked electrically.

He would compare the transmission of electrical energy: A. By means of naked conductors suspended from telegraph poles, which system would work well on tramways passing through open country. B. Underground conductors placed in a channel between the rails or on the side of the rails. C. Accumulators. As accumulators replaced only the conductor, he would leave out of the calculation all expenses relating to permanent way, generating plant, etc., and consider merely the cost of conductors as compared with the cost entailed by using accumulators. He would assume the line to be 1 mile long, with two cars for the accommodation of 46 passengers, running on it at an average speed of, say, 6 miles an hour. With the conductor system this could easily be accomplished with 30 ampères, at an actual pressure of 250 volts.

He took for conductor—

	£	£
A. The cost per mile to be		200
B. " " "		1,500
(which was a liberal allowance in each case; the figures had been taken from a *bona fide* tender.)		
C. When using accumulators, 1½ ton of cells would be required per car; three sets, 4.5 tons or two cars, 9 tons, at £60	540	
Increase in cost of cars, motors, etc., 50 per cent.	270	
Total	—	810

Say £800. Assuming interest and depreciation of conductors A and B at 10 per cent., and of accumulators at 30 per cent., which was rather in favor of the accumulators, the differences of depreciation of the two plants were 20 per cent. Now, in order to put both systems on the same footing as regarded depreciation, the actual cost of accumulators must be increased by the capitalized difference of depreciation of the two plants. Thus £1,000 invested in conductors would annually depreciate at the rate of $100, while with accumulators the loss would be £300, and would correspond to an outlay of £3,000 with a depreciation of 10 per cent. For this comparison, therefore, the actual cost of the accumulator plant must be trebled. It was clear that in case of an increased traffic the capital outlay on the continuous conductor system would increase only nominally by the extra weight of copper to be added to the conductor. An allowance of £25 per mile for every two additional cars (30 ampères) would be ample. For accumulators the question was different; in this case, the cost of the accumulator-plant must be multiplied by the number of cars to be run. The following table was calculated for various lengths of line and various numbers of cars:

COST OF CONDUCTOR AND ACCUMULATOR PLANT.

Length.	Two cars.			Four cars.			Six cars.		
	A.	B.	C.	A.	B.	C.	A.	B.	C.
1 mile	200	1,500	2 400	225	1,525	4,800	250	1,550	7,200
2 miles	400	3,000	2,400	450	3,050	4,800	500	3,100	7,200
3 "	600	4,500	2,400	675	4,575	4,800	750	4,650	7,200
4 "	800	6,000	2,400	900	6,100	4,800	1,000	6,200	7,200

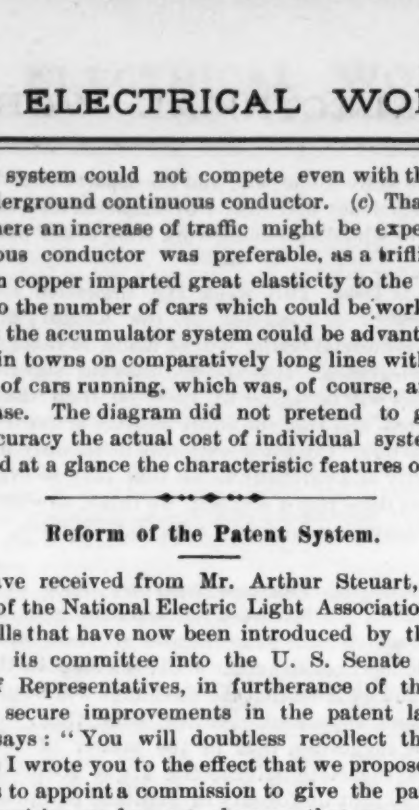
Length.	Eight cars.			Ten cars.		
	A.	B.	C.	A.	B.	C.
1 mile	275	1,575	9,600	300	1,600	12.000
2 miles	550	3,150	9,600	600	3,200	12,000
3 "	825	4,725	9,600	900	4,800	12,000
4 "	1,100	6,300	9,600	1,200	6,400	12,000

The values in this table had been used to prepare the diagram, Fig. 1. The ordinates represented the cost, and the abscissæ the number of cars. The four thinner lines at the bottom of the diagram represented the cost of conductor placed on poles for 1, 2, 3, and 4 miles. The four dot-and-dash lines above represented the cost of conductor in a slotted underground channel. The diagonal line across the diagram represented the cost of accumulators, and was independent of the length of the line, but was very much dependent on the number of cars running. This diagram showed: (*a*) That wherever an aerial conductor could be used, the accumulator system could not compete with it, however small the traffic, if the length of the line did not exceed, say 10 miles. (*b*) That for heavy traffic the accumulator system could not compete even with the expensive underground continuous conductor. (*c*) That in each case, where an increase of traffic might be expected, the continuous conductor was preferable, as a trifling extra outlay in copper imparted great elasticity to the line with regard to the number of cars which could be worked on it. (*d*) That the accumulator system could be advantageously applied in towns on comparatively long lines with a small number of cars running, which was, of course, an exceptional case. The diagram did not pretend to give with great accuracy the actual cost of individual systems; but it showed at a glance the characteristic features of each.

* Extract from Proc. of Civil Engineers. An expansion of a speech delivered during the discussion of Dr. Hopkinson's paper on the Bessbrook & Newry tramway. See THE ELECT. WORLD, Jan. 14, 1888.

Reform of the Patent System.

We have received from Mr. Arthur Steuart, general counsel of the National Electric Light Association, copies of the bills that have now been introduced by that body through its committee into the U. S. Senate and the House of Representatives, in furtherance of the movement to secure improvements in the patent law. Mr. Steuart says: "You will doubtless recollect that some time ago I wrote you to the effect that we proposed to ask Congress to appoint a commission to give the patent law general revision, and report changes that were thought desirable to Congress. This plan has, however, been abandoned in consequence of the great opposition that was expressed to it among many of my legal brethren in different parts of the country, who feared that the opening of the door to general revision would be used by the enemies of the system as an opportunity to renew their attacks upon it and do it serious damage. We have, therefore, determined to introduce the inclosed bills, which strike at three special measures which we think of great importance, and which we feel will be of material advantage to the system if they can be accomplished. We propose to remove the limitation of United States by foreign patents by the means suggested in the proposed bill. We have attempted to give greater stability to the position of Commissioner of Patents, and thereby simplify and establish a practice in the Patent Office, by increasing the salary of the Commissioner of Patents to $8,000, and giving him a fixed term of six years. This we feel will induce a good man to retain the office for a considerable period, unless removed by an incoming administration, and we think that a fixed term of office will put some obstruction in the way of an incoming administration that may be disposed to remove a good incumbent. The Court of Patent Appeals suggested, we feel, will be a matter of great importance, in that it will provide a court thoroughly equipped to decide technical cases, and it will place over the two branches of the government having to do with patents, the Patent Office and the Circuit Courts a strong harmonizing influence. It will also greatly facilitate the final determination of cases that are appealed from the circuits, and it will relieve the Supreme Court of about one-tenth of its docket."



ACCUMULATORS VERSUS DIRECT CURRENTS FOR TRACTION.

The bill for a court of patent appeals provides for a Chief Justice and associate justices, before whom shall be heard all cases hitherto appealable to the Supreme Court, except that a final appeal to the latter may be had when, the amount in any single case reaches $100,000, exclusive of costs, if the patent court consents. Each of the patent judges shall receive $8,000 per annum. The court is to have a clerk, marshal and reporter. One term annually is to be held, beginning on the second Monday in October. It will have appellate jurisdiction in cases brought up from the U. S. Circuit Courts, the Supreme Court of the District of Columbia, and the Commissioner of Patents. In the last respect the court will consider all cases from the Patent Office touching patentability of inventions, priority among claimants, and judicial practice in the office.

The second bill, as above stated, fixes a long term for the Commissioner of Patents, increases his salary, and provides for an assistant at $3,000 and three examiners in chief at $3,000 each. The third bill is that which seeks to clear up the present trouble that arises from the limitation that has been put on American patents by the expiration of identical foreign patents.

Reduction of Insurance for Electric Lighting.

It is important and interesting to note that at the meeting of the New England Insurance Exchange, held at Boston on March 31, a vote was passed giving a reduction in the Exchange tariff, for the use of electric lights, under the required conditions. A reduction of 10 cents is made for incandescent lights used in establishments enumerated in the ordinary schedule or list, and of 5 cents for arc lights. With regard to this significant action, Mr. S. E. Barton, who is the chairman of the electric light committee, and is well known to electric light men in connection with this special branch of insurance work, says: "This is the action referred to in my Pittsburgh paper, which seemed to strike the electric heart in a tender spot. I think it cannot now be said that we do not believe in our own position, nor that we are unwilling to acknowledge, in a substantial way, the benefits and improvements which we claim are the result of our enforced inspection. If the electric light interests could secure similar inspection throughout the country and pay for it, they would most surely reap, in time, benefits such as we believe they will reap in New England from our present action. It is the only way to effectually drive from the public mind that mysterious fear of the electric wire that seems to possess them to such an extent; even the mind of the newspaper reporter, who certainly ought to be more enlightened."

Kapp or Silvey?

To the Editor of The Electrical World:

SIR: I always open your valuable paper with a pleasant feeling, anticipating that I shall find some interesting matter in your pages. In this I am never disappointed; but your issue of the 10th of March brought me a really startling surprise. On page 125 you illustrate a dynamo which at the first glance seemed familiar to me, and upon closer inspection I found that it is the very illustration of the Kapp dynamo which I have given in my book on "The Electric Transmission of Energy" (page 269) and which Messrs. W. H. Allen & Co., the makers of this machine, now use in their advertisements. The fact that Mr. Silvey has adopted a type of machine which some years ago I was the first to introduce in England (though I believe M. Gramme introduced the same type either simultaneously or even a little earlier in France) is not a matter which surprises me much. My English friends have accustomed me to this, for several firms have recently adopted the same type.

There is, however, this difference. The English firms to which I alluded have a perfect right to adopt a type which is not patented, and the authorship of which may be considered a debatable question. Some of my English friends are kind enough to attribute it to me and others do not; but not one of them in adopting this type has actually copied my design. This, to judge by the cut in your issue of March 10th, Mr. Silvey seems to have done. But he has done more. Not only has he copied my design, but he has also used the engraving of my machine to advertise in your columns what he is pleased to call the Silvey dynamo.

Since I brought out the design which Mr. Silvey has copied I have made several modifications and improvements, and I am not going to quarrel with him for imitating a design which is now almost obsolete. But in case he should pay me the compliment of copying one of my later designs, I should advise him to advertise it at least in a cut of his own so as not to be so easily found out.

GISBERT KAPP.

WIMBLEDON, March 24, 1888.

[We were ourselves very much struck with the similarity to an early Kapp machine, and mentioned the fact, it will be remembered, at the beginning of the article.—EDS. E. W.]

Carnot's Law.

To the Editor of The Electrical World:

SIR: On page 105 of your issue of Aug. 20, 1887, in the article on the "Pyro-Magnetic Generator," are these words: "The thermo cell appears to follow precisely the law of Carnot, and hence can have at the most no higher efficiency than the reversible engine of this eminent philosopher." I would like to know of this "law of Carnot," and further of the efficiency and experiments in the construction of the thermo cell. Can you direct me in the matter?

BOSTON, Mass. CONSTANT READER.

ANSWER.—Carnot's law as expressed by Thomson is as follows: "The ratio of the greatest possible work performed by a heat engine, to the whole heat expended, is a function of the two limits of temperature between which the engine works, and not of the nature of the substance employed." The thermo cell is referred to as a class, no particular one being intended.—EDS. E. W.

The Lag in Transformers.

BY W. E. AYRTON AND JOHN PERRY.

As the subject of transformers is now exciting much attention, it may be interesting to mention without now going into the details of the experiments that the investigations of the third year students of electrical engineering at the Central Institution made on a closed magnetic circuit transformer have shown:

1st. That the lag between the currents in the primary and secondary circuits is practically 90° *in excess* of what it would be if there were no self-induction or magnetic lag—that is, the currents in the two coils are nought simultaneously.

2nd. That the magnitude of the ratio of the coefficient of self-induction of the secondary to its resistance is a sufficient and necessary reason for this extra lag of 90°.

The Brush Electric Light Station at Rochester, N. Y

The Brush Electric Light Company's station at Rochester, N. Y., is located at the foot of the Lower Genesee Falls, two and one-half miles from the centre of the city. The Falls, Fig. 1, are 94 feet high and about 350 feet wide. The river bank, just east of the station, is a perpendicular height of 187 feet. The station is built of stone, three stories high, 45 feet wide and 95 feet long, with iron joists and rafters and corrugated iron roof. The first story is used for tail races for discharge water from the turbines; the second story, contains the turbine wheels, shafting and repair shop. All the repairs to dynamos, etc., are made at the station. The dynamos and switch-board are in the third story, Fig. 2.

The turbine cases are placed on heavy iron beams set into the solid rock, and the shafting extends directly from the turbines and runs at a speed of 800 revolutions per minute. The bearings are all placed on iron bridge trusses that are securely bolted to iron beams and posts. Walks are placed a few inches above the shafting so that the shafting and bearings can be easily and safely taken care of. Tallow and lard oil are used as lubricants. There are 15 double 15-inch Lesner turbines of 300 h. p. each, set horizontally with 14 feet draft tubes, not using any wheel step or gears.

There are three penstocks, 6 feet in diameter, made of heavy boiler iron and bolted to the solid rock. At a point 75 feet from the top of the penstocks an elbow branches off to each turbine, so arranged that each can be used independent of any other. They are started and stopped by hand wheels placed back of and near the switch-board. At present twelve turbines with automatic governors are in service. The flume rack near the top of the penstocks is made of iron slats ½ inch apart and placed at an angle of 45°. As a further protection a heavy horizontal wooden rack is placed in the race midway between the flume and the headgates.

The dynamo room is well lighted by eight large windows, and ventilated by the elevator shaft at one end and a four-foot New York exhaust ventilator at the opposite end. The elevator is run by a turbine and will carry a load of nine tons. The dynamos are placed in rows lengthwise of the building, on heavy wooden frames 22 inches high, bolted to 12-inch iron floor joists and belted direct to the turbine shafting below. At present there are twenty-four No. 8 and two No. 7 Brush dynamos (65 and 28 lighters), so arranged that a spare dynamo and turbine is always in readiness. The machine wires are carried in uncovered grooved P. & B. painted boards on the ceiling of the shafting room to the switch-board in south end of the dynamo room. The circuits and switch-boards are protected by lightning arresters. From the switch board the circuits, of which there are twenty-four, are run up the elevator well on each side of the elevator way. The circuits average fifteen miles in length and are tested five times daily, a record being made.

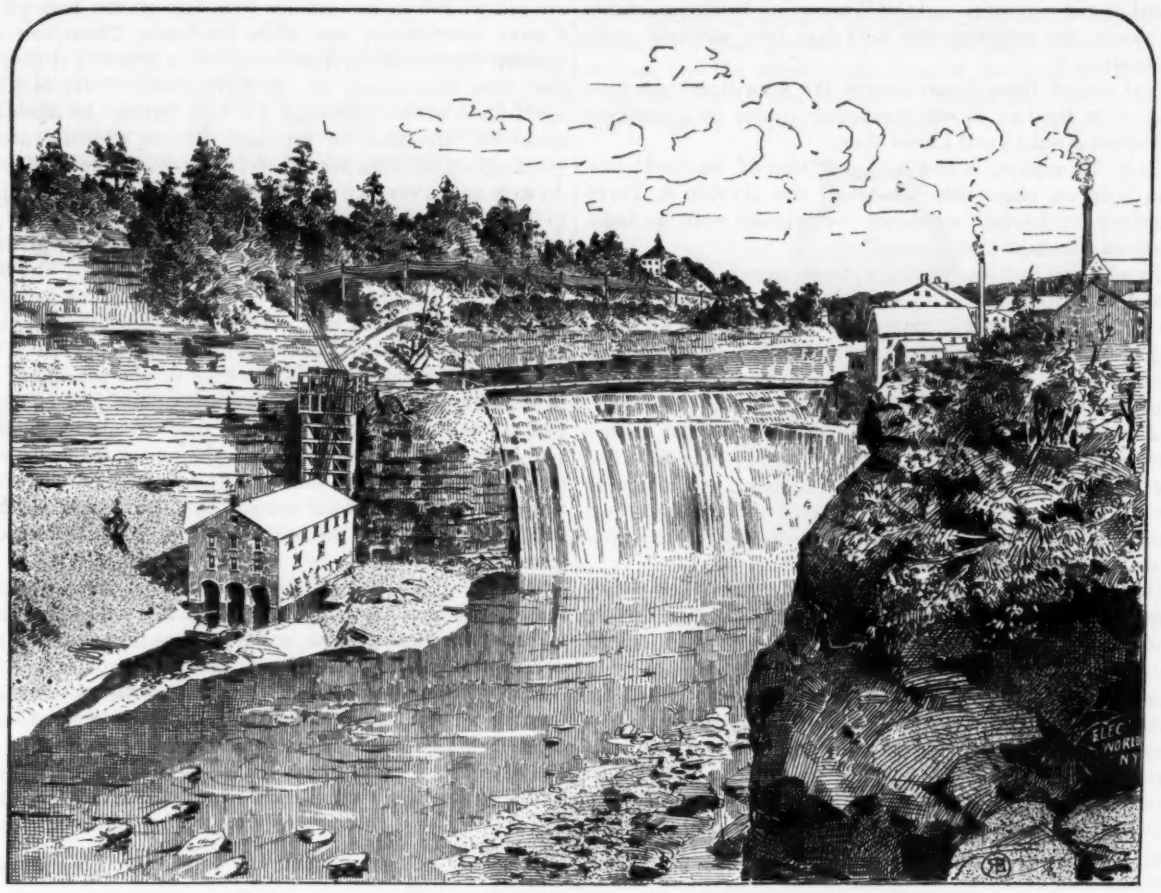


FIG. 1.—WATER POWER OF THE ROCHESTER, N. Y., BRUSH ELECTRIC LIGHT STATION

The company have in service at present 1,100 arc and 1,025 incandescent lamps and are increasing the number steadily. They also have 182 motors in service from ¼ h. p. C. & C. to a Brush 8 h. p., and furnish power for eight printing offices, three laundries, thirty-eight tailor shops, two bakeries, one large elevator and for ventilating purposes in several restaurants and schools. They have also put in at Ontario Beach (summer resort) eighty-four arc lamps, and it is proposed to light the road from Rochester to Lake Ontario, a distance of seven miles, the coming summer.

The officers of the company are George E. Mumford, President; Chas. B. Griffith, Secretary and Treasurer; Geo. A. Redman, General Superintendent. Mr. Redman, to whom we are indebted for the interesting information above given, has been superintendent for 5½ years. He was formerly a telegrapher, then in due course became manager of an Edison telephone exchange, and finally found the largest field of opportunity in his present work, the management of one of the largest electric lighting plants in the world, and it is believed the largest of all run by water power.

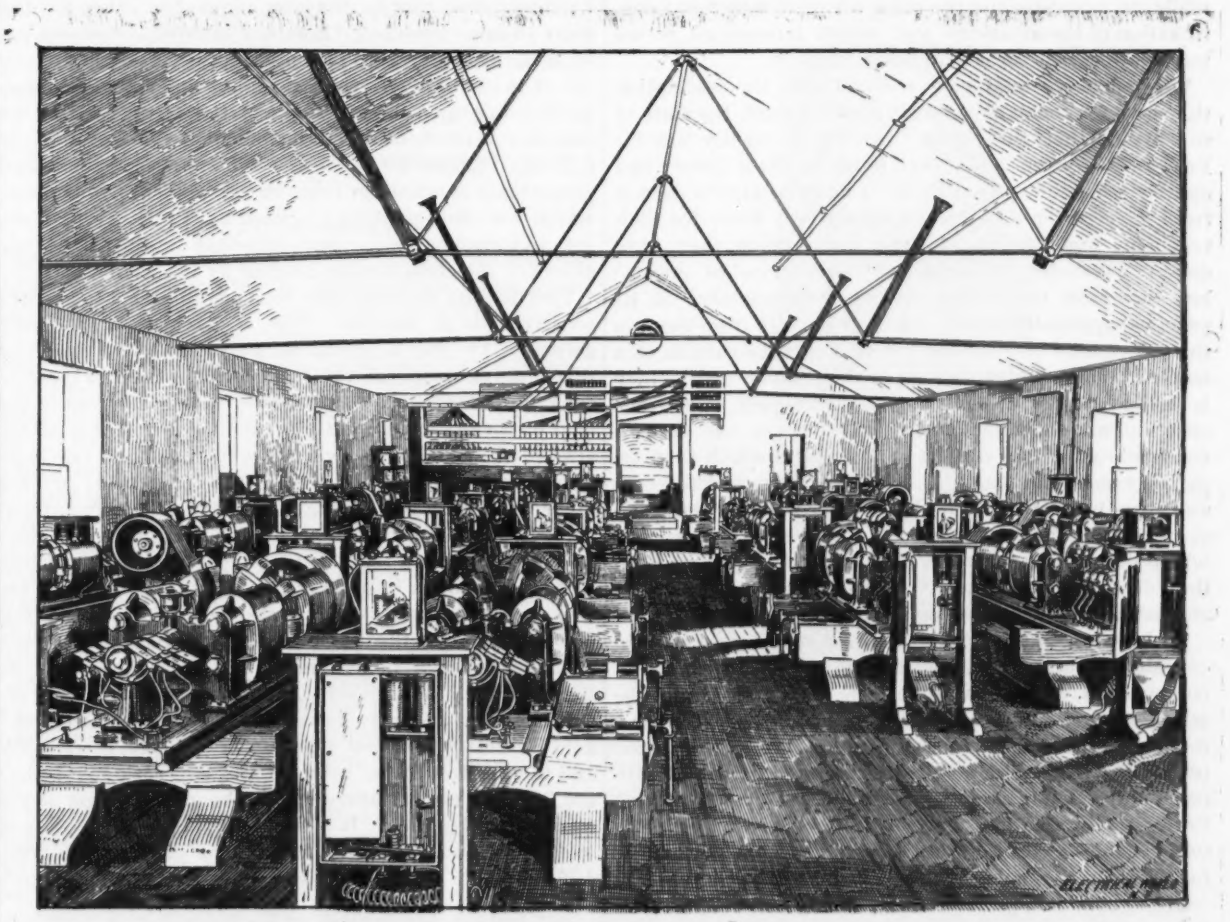


FIG. 2.—DYNAMO ROOM OF THE ROCHESTER BRUSH STATION.

Priority of Invention in Methods of Motor Regulation.—II.

BY FRANK J. SPRAGUE.

I shall now show the incorrectness and, as it seems to me, either the gross ignorance or willful misrepresentations of certain statements which have been made. Let us see what Professors Ayrton and Perry did in 1882 and 1883. The first patent which I have been able to find of Professor Ayrton relating to this subject is that of which a complete specification was filed in December, 1882. When it was made public, I do not know because I am not sufficiently familiar with the methods of procedure in the English Patent Office at that time, but reference is generally made to their paper before the Society of Telegraph Engineers and Electricians, May, 1883. After describing several impracticable methods of governing the speed, they go on to describe their particular differential method in the following words:

"Another method which we employ consists in the use of a magneto-electric machine; the field magnet is made permanently a magnet, but it is also wound with a coil of wire which is in the same circuit as the armature and whose effect is to diminish the magnetism of the permanent magnet when the current passes through the motor. The dynamo part helps the current and uses up mechanical energy, thus acting as a 'governor' to the magneto part, which is really a motor and which converts electrical energy into mechanical energy. A magneto machine, gearing into a very much smaller dynamo machine, both in the same circuit and regarded as one motor, may also be used. In any case the constant electromotive force which is maintained externally, the resistance and constant of the machine or the machines, and the speed, are matters we determine very accurately by means similar to those described in the above-mentioned Patent Specification No. 55 (1882). A shunted motor may also be employed, that is a shunt circuit is coiled on the field magnet and produces a permanent magnetic effect, but there is also a coil on the field magnet which is in series with the armature, and which is so arranged that when the current passes the magnetism is weakened."

They then describe certain methods for the determination of the winding for this motor, which is based upon the electromotive force which the machine will develop with some particular speed and winding, and then give a series of equations and actual winding based upon the space required by the wire and certain relations of resistances (page 8, lines 13 to 21), to which I shall make reference later. On page 11 is found the claim covering this, as follows:

"The construction of a motor whose field magnet is

mainly wound with a shunt circuit to the whole machine, but is also partially wound with wire in the same circuit as the armature in such a way that the current diminishes the magnetism produced by the shunt circuit, for the purpose of obtaining constant speed independently of the load, when there is a constant or a nearly constant difference of potentials maintained between the terminals of the motors, or when there is a constant or a nearly constant current supplied through the motor, substantially as described." This is a description, pure and simple, of what is now known as a long-shunt machine, that is, a machine which has one fixed component in the field magnets, and one variable one which is dependent upon the armature. They propose the utilization of the short-shunt machine (which actual connections of course are not new with Ayrton & Perry), for regulation on a *constant current circuit*, but do not claim it, do not describe it,—do not in any way set it forth as being of use when properly proportioned for the purpose of regulation on a constant potential circuit, on which of course the conditions are entirely different.

To see if this view of their patent is the correct one, let us look at the description of their machines which they gave before the Society of Telegraph Engineers and Electricians, and which is quoted at length in the London *Electrical Review* of August 18, 26, September 1, 8, 15 and 22, 1886. The article which has particular reference to this matter is found in the issue of August 18, to which I beg to call particular attention. The class of machine to be used on constant potential circuits by Professors Ayrton & Perry is diagrammed very clearly in Figs. 8 and 13. They here give the key to their line of reasoning when they say: "This combination of motor and generator brake is the gist of our method, and the exact combination we employ in any particular case depends upon what are the supply conditions—that is to say, whether constant difference of potential is kept up at the terminals of the motor, or constant current is passing through the motors."

They go on to state, in describing the long-shunt machine, that it is to "be remembered that the supply condition we are dealing with is 'constant difference of potentials at the terminals of the motor,' hence, the current which passes through the shunt circuit will be a constant current, and the iron of the field magnet, so far as this current is concerned, will act as a permanent magnet. The current then passing through the shunt circuit magnetizes the field magnet, as shown in the figure, but in addition the wire which forms part of the armature is wound round this field magnet in such a way that the current passing through it tends to demagnetize the field magnet, and here, as before, the armature and shunt circuit act as a motor, while the armature and the thick wire coil, which is a continuation of the armature, and which is wrapped round the field magnet, form a brake-dynamo."

This, when we take into account also the description they give for constant current machines and the state of the art at that time, fixes very clearly exactly how far Professors Ayrton and Perry went in their theory and exactly what they meant by it. I have no wish to detract from the credit due Professors Ayrton and Perry for their ingenious methods and for the work which they have done in advancing the electrical transmission of power; but they have made some very serious mistakes in its practical application, and I differ radically from them in the principles which should govern the construction of a motor. While ready to accord to them every credit which is theirs, I cannot, either in justice to myself or any one else, assign to them, as Professor Thompson has done, a consideration of the subject in a light in which they apparently never did regard it, a series of laws which do not and never have characterized the construction of their machines and methods of connection for certain purposes, which they never proposed, either in their patents or in their descriptions, and which they have never yet used in any machine which they have constructed.

As I have pointed out, Professors Ayrton and Perry, in considering the regulation of the motor, considered it as a combination of two machines, one as a motor and the other as a brake-dynamo, the armature being driven as a motor in a constant and permanent field, and as a dynamo in a field produced by a coil in series with itself and with itself only. I think that this view of the case prevented Professors Ayrton and Perry from seeing that, by using two variables instead of one variable and one permanent function in the field magnets, precisely similar results could be obtained, and that in the use of two variables there would be opened up a large variety of special combinations. On the contrary, I considered purely and simply the question of the amount of power developed by the motor, its relation to the current and to the motor or counter electromotive force, and upon what this counter electromotive force depended; and there resulted from these considerations what Professor Thompson has pointed out, viz., that both the long-shunt and short-shunt machine could be utilized for regulation; and I developed the following forms.

The plain shunt machine, with hand or mechanically automatic variation of field-magnet strength; that is, a machine having one variable component in the field.

Then the long shunt, with symmetrical field, the long shunt with distorted differential field, the right-angled winding, in which the coarse and fine fields set up polarities at right angles to each other. These three varieties have one fixed and one variable function in the field-magnets, the governing coil opposing the action of the fine coil, in the one case directly and in the other in a distorted manner.

I further developed the short shunt, the combined long and short shunt, the distorted, cumulative and differential windings both for long, short and combined long and short shunt machines and the Wheatstone bridge machine. In these last varieties the field has two variable components.

Not one of these forms except the long-shunt machine was ever used as a self-regulating motor on a constant potential circuit until I used them.

Prof. Thompson, in the second edition of his book, in a foot-note on page 433, speaks of the Ayrton & Perry machine as having windings "combined with an independent constant magnetism."

In addition to these varieties there were several others which had different methods of hand and automatic control. In the automatic machines, of course, the ultimate object of all these methods is to weaken the motor electromotive force of the motor when the load is increased, provided we are working on the first or highest economy, and since none of these forms of motors existed before Messrs. Ayrton & Perry or myself developed them, it follows that the specific laws and connection by means of which the motors should be constructed are the things which, in themselves, constitute invention, and for which those who devised them are entitled to credit.

It can hardly be supposed, despite Prof. Thompson's assertion, that, had Professors Ayrton and Perry fully understood these different connections, and realized that they could be used on a constant potential circuit, that in a patent which is so full of details, and in a description so elaborate as that read before the Society of Telegraph Engineers and Electricians, they would not have mentioned and claimed these various combinations. Few persons will admit this for a moment, nor do I believe that Professors Ayrton and Perry on a thorough consideration of this subject, would themselves claim it, although it is claimed for them.

As I have stated, there are, of course, several laws of winding, these laws of winding being simply questions of proportion which pertain to these different varieties of machine, one being for the long, another for the short-shunt, another for the combined, and others for the distorted windings, and these depend upon the types of machines. Two only were given in the articles referred to on the Sprague motors, which article was published. One was called the "first" and the other the "second" law of winding. One was for the long shunt; the other for the short shunt. Professor Thompson ignored the second law of winding, which is, in some respects, a much prettier law than the first. In the long-shunt machines, the winding depends upon the resistance of the series coil; in the short-shunt machine it is independent of the resistance of this coil. Let me go further. I will show that the actual proportions of winding, even in the long-shunt machine, which were first publicly proposed by Prof. Ayrton, are not and cannot be the same as would obtain in the machines of the construction adopted by the writer.

Two distinct theories have been advanced for the proper construction of motors. One is advocated and ably defended by Profs. Ayrton & Perry, and is to the effect that different general principles should govern the construction of dynamos and motors; that in the former the field moment should greatly predominate over that of the armature; while in motors the moment of the armature should greatly predominate over that of the field. On the other hand, I think I am right in stating that Prof. Rowland, Dr. Hopkinson, Messrs. Mordey and Kapp, hold with myself the opinion that the best apparatus for converting mechanical power into electricity must necessarily be the best apparatus for converting electricity into mechanical power, and that the principles governing the best electrical construction of one must also be the best for constructing the other. In short, in motors as well as in dynamos, we should aim to have the most intense magnetic field possible, the lowest armature resistance practicable, and the greatest ratio between the magnetic moment of the field and the armature which the construction of the machine will permit. It is true that the great varieties of work demanded of motors make their construction often different from dynamos; but this does not affect the truth of the principle involved.

It was pointed out in the article that both in the long and short-shunt and combined windings, if the circuit were closed to the machine in its normal condition, the proportions of the windings were such that there would be an absolutely dead field, the ampère turns in the series and shunt-coils being exactly equal.

If we refer to Prof. Thompson's work, we find on page 452 of the second edition the following statement: "There is, however, one serious difficulty presented in the workings of the differentially wound motors constructed on the theories of Profs. Ayrton and Perry; if the current is suddenly turned on to start them, seeing that the armature is standing still and is not developing a counter electromotive force, the greater part of the current runs through the armature and series coil, and very little through the shunt. The result is that the shunt coil, which ought to provide the chief part of the magnetizing, is less powerful than the demagnetizing series coil, and the motor starts the wrong way."

In other words, according to Professor Thompson, the ampère turns of this series coil are greater than the ampère turns of the shunt coil; that is, the weakening action of the series coil of the armature is greater than should exist. In fact, the actual machines, as constructed, are not wound in accordance with any of the laws which I have enunciated, but, since Professor Thompson has been so inaccurate in describing other matters, it may be that this description of the Ayrton and Perry motor is itself inaccurate, although he can hardly be mistaken about the direction of rotation. Hence we will turn to the English patent already referred to and take Professors Ayrton and Perry's own words as found on page 9, lines 13–21, as follows:

"Let us take $R = 0.16$ and $N = 1{,}000$. Also arrange that the regulating coil is to occupy one-fifth of the field magnet coil space. Then $y = 5$, and $x = 1.25$: so we find that $b = 0.053$ and $a = 0.113$. $K = 0.00016$ and $\rho = 0.000132$ ohm. When, therefore, the regulating coil ρ has this resistance and occupies one-fifth of the volume of the field magnet winding, and when the shunt part occupies four times as much of the equally useful volume, and has a resistance of 100 ohms, when the armature resistance together with that of the regulating coil is 0.1601 ohm, this motor will run at 100 revolutions if a constant difference of potential of 100 volts is maintained between its terminals."

This is explicit enough, and it is to be presumed that these gentlemen knew as much about this winding of their machines as any one else, and hence we may make a few deductions from the above.

If the coarse and fine coils have the same mean lengths of turn, and the ratios of thickness of insulation to cross-sections of wire are equal, then we have with the above proportion of space occupied, letting m and n represent the number of turns of fine and coarse wire, the ratio of resistance necessarily expressed by the equation $\frac{m^2}{4\,n^2}$; and substituting the values given, we have:

$$\frac{m}{n} = 2\sqrt{\frac{r}{\rho}} = 2\sqrt{\frac{100}{.000132}} = 1740.$$

Referring to the first Sprague law, we find that with the resistance given we ought to have:

$$\frac{m}{n} = \frac{r}{R+\rho} = \frac{100}{.1601} = 625.$$

Are these figures, 1740 against 625, sufficiently explicit to show the inaccuracy of Prof. Thompson's statement that the first *law of winding* is an Ayrton and Perry law?

The second method not having been used by these gentlemen for this purpose, I cannot make any comparison of figures to show variations of their practice from the second law; but if a motor of their type were thus connected, it would not be wound as demanded by the second Sprague law. It seems then that, notwithstanding Prof. Thompson's self abnegation, the question of priority of statement of this first law (there is none about the second) lies between himself and me, and since he has practically intimated that I am indebted to him for his knowledge, I may as well dispose of this at once.

In 1884, before the first edition of Mr. Thompson's work on dynamo-electric machinery appeared, he favored this country with a visit. While here and attending the Electrical Exhibition at Philadelphia, he came across a little exhibit of motors made by the writer. There were seven of them, differing somewhat in type and characteristics, and varying from 1½ to 6 h. p., all of high efficiencies. The mention of the characteristics of these machines in the catalogue might well attract the attention of the scientific student, for here were motors for constant potential and constant current circuits; motors to run automatically at constant or variable speed; constant speed motors which could be started under a load gradually, and would run with fixed brushes without sparking; a motor which could be set to run at different constant speeds, and to run in either direction; and a motor which could be run fast or slow, forwards or backwards, capable of reversal, when running at a high speed without a sign of a spark, and presenting some other peculiarities, such as the converse or direct variation of field strength to get increase of speed or torque, when working above or below the fifty per cent. limit. When, after some general conversation on the subject of motors, Prof. Thompson suggested that I explain the construction of the machines, I declined because of patent complications, making an exception, however, in the case of the last-named machine, which I thought I quite fully explained. This machine, intended for demonstrating the possibilities of motors for variable work, had no attachments for controlling the speed automatically. How erroneous an idea of the subject Prof. Thompson got may be seen by the entirely incorrect statement that appears on page 447 of his 1886 edition as follows:

"Motors governed on this principle (Wheatstone bridge) have more lately been constructed by Mr. F. J. Sprague. They show remarkably good regulation."

I may as well state now for Prof. Thompson's information that the motors which ran at so constant a speed were

constructed with a distorted differential winding on one of my own laws.

In referring to his 1884 edition, as containing the first law of winding, Prof. Thompson probably unwittingly lays himself open to the charge of inaccuracy.

Turning to this reference, we find on page 367, equation LIV. as follows:

$$\frac{z}{s} = \frac{r_a + r_m}{r_s};$$

and referring to page 180 for a translation of the symbols, we find the law to be as follows:

The number of turns of wire in the shunt field is to the number in the series field as the sum of the resistance of the armature and series field is to the resistance of the shunt field.

This is the exact reverse of my law, and a machine so wound would begin to run faster the moment the load was put on it, would increase very rapidly and then suddenly stop, reverse and run backwards at a slower speed.

In the second edition of his work, published in 1886, while using identically the same symbols on page 242 as in the previous edition, Prof. Thompson on page 451 gives the proper law by inverting one member of the equation as follows :

$$\frac{s}{z} = \frac{r_a + r_m}{r_s}$$

Possibly Prof. Thompson may plead that this was an oversight, or a typographical error, as it probably was. In view of the fact that the change was made in the second edition, and that reference was nevertheless made in his criticism to both editions, would not candor and fairness have led Frof. Thompson to make some reference to a change with which he must have been familiar?

And now as to Mr. Mordey. His definition of the principles I have enunciated, being meagre and inaccurate, is misleading, and reference to existing works on the subject of motors will not bear him out. My statement was not simply that a motor will run faster with a weak field than with a strong one, nor is it necessary that it shall so act. The conditions under which a motor is running determine whether a weakening of the field will make it run faster or slower. The principle in its broad sense is as I have already given it, and was first enunciated by me.

Mr. Mordey cannot rightly treat this in the light of today, when motors have been brought to very high efficiencies.

How little the principle was generally understood may be seen from the fact that Prof. Thompson has never yet published it, and the nearest reference he has made to it is found in his 1886 edition on page 456, where, referring

FIG. 1.—A NEW REFLECTING GALVANOMETER.

to the experiments of Messrs. Mordey and Watson, these words appear:

"With a lower electromotive force the same motor regulated in shunt almost equally well, but at a lower speed it was observed that, especially when the motor was giving out small horse-power, its speed was increased by *weakening* the field." Why this surprise?

How *important* the principle is may be inferred from the fact that the published commercial efficiency of the Ayrton and Perry motor in 1884 was thirty-five per cent., which shows that when developing its full normal power the armature must have been working dangerously near the fifty per cent. limit, while with the present efficiency of the motors developed on my own principles they would be theoretically run at a constant speed and full normal load, with the potential dropping from 220 to 90 volts.

In 1886 Mr. Mordey published an account of some interesting experiments, showing that a motor properly designed, having an intense magnetic field and an armature of very low resistance and magnetic moment, will regulate very closely under varying loads. This has been called a discovery. It might better be termed a true development of the correct principles of motor construction.

Precisely similar results have been developed in my own practice, and in a perfectly independent manner, but I certainly would not presume to question the originality of Mr. Mordey's work, whatever its relative novelty may have been. He has seen fit to publish his experiments; I have deemed it best to keep my own practice to myself, not only in this but in many other lines, as all manufacturers must do for their own protection. And yet I have large numbers of shunt machines running to-day depending solely for their governing upon the proportions of the machine, and the slight weakening of the field produced by the reactions of the armature. Since Mr. Mordey has made reference to past dates, I may as well mention that

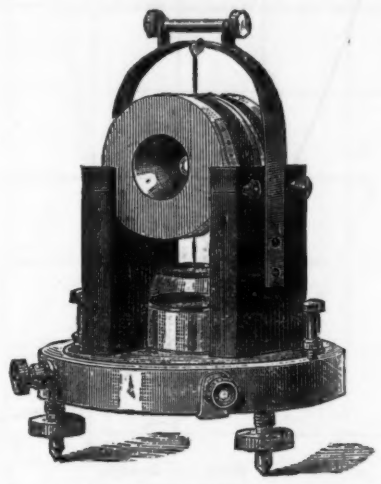


FIG. 2.—A NEW REFLECTING GALVANOMETER.

in the early part of 1883 he will find that there was filed in the United States Patent Office a machine invented originally when I was in France, one form of which operated to run at a constant speed by raising the potential existing at the armature, and at the same time reducing the cumulative action of coils in series with the armature. These were also arranged so that they could be made either differential or cumulative.

I regret that this reply has been necessarily so long, for I have no desire to needlessly encroach upon the valuable space of this journal, nor have I either the time or inclination to enter into an interminable discussion. The facts are simply as I have stated them. The public, and, in time, the courts, can decide as to them. When, however, Prof. Thompson, or any of the other gentlemen who have been mentioned in this discussion escape from the confines of the British Isles to this benighted country, they will find myself and associates entirely willing now to show them original models if they wish to indulge in research, or, on the other hand, the most extensive and varied existing application of motors in the arts.

A New Pattern of Reflecting Galvanometer, with Lamp and Scale.*

BY G. L. ADDENBROOKE.

The instruments which I am about to describe are the outcome of improvements and modifications which have suggested themselves from time to time as the result of a good deal of experience in electrical testing for telephonic, electrical lighting, and general experimental purposes. As usually constructed, the reflecting galvanometer is essentially a laboratory instrument, demanding care and skill for its management, besides being costly. Perhaps the greatest objections to it are, however, the difficulty of moving it and setting it up, and the time usually taken to put it right when it gets out of order. When, however, it is in good working order there is so much satisfaction in working with it that one returns with reluctance to the use of other instruments.

In the instrument before you it has been my aim, while preserving to the full the sensitiveness usually obtained in good laboratory instruments, to simplify and alter the construction, and thus fit it better for everyday needs, without at the same time diminishing its efficiency for the work with which it is now more particularly associated.

It is constructed as follows: Fig. 1 shows the instrument complete. The base is circular and 5 in. in diameter. The case is of brass, its top being 6 in. above the base. The adjusting magnet, which is removed for carriage, rises 8 in. further. The instrument is thus very small and compact. The adjusting magnet works up and down on its rod, a slot in the rod preventing lateral movement. Lateral movement is provided for by rotating the top of the case, which is marked with degrees so that the magnet can always be brought back to the same position again directly if it is necessary to move it. The spirit level or levels for setting the instrument are on the top of this lid. The case itself is provided with two L pieces at the bottom engaging the two screws with milled heads on the base. By giving them half a turn, and rotating the case slightly, it can be lifted off.

Fig. 2 shows the appearance of the instrument when the case is taken off. Rising from the base are two parallel uprights of ebonite; four brass rods pass up through these, holding them in their places on the base, and forming the means of connecting the terminals with the wire on the bobbins. Further, there are four small thumb screws, placed near the top of the ebonite uprights, two on each. These screws pass through the brass rods I have mentioned, and into the outside cheeks of the bobbins.

The shape of the bobbins will readily be seen in the figure. The outside cheeks are left much thicker than the inside, and all the cheeks project about ⅛ in. beyond the coils of wire. The lower halves of these projecting cheeks are cut away at the sides, as can be seen in the figure, leaving the upper portions projecting, so that the coils rest on the projecting portions on the ebonite uprights and slide exactly into their places. The cut-away portions of the thick ends of the bobbins are faced with brass plates, to which the ends of the coils are soldered. The thumb-screws above mentioned screwing into the brass plates complete the connections and hold the bobbins firmly in their places.

Both bobbins can thus be taken out in a moment without disturbing the needle; there are no awkward connections to make or to get out of order, and if desirable several sets of bobbins can be made, wound with different lengths and sizes of wire to fit the same instrument, which can be interchanged without trouble at any time.

Now we come to the needle. The suspension is of quite a different type to that usually employed. A brass hoop will be observed passing over the centre of the bobbins and screwed at either end to the ebonite uprights. The whole galvanometer is put in the lathe and a very small hole bored centrally through this brass hoop. A V-shaped slot is then cut in the brass hoop from the front toward the back of the instrument, the point of the V-groove ending in the small central hole. About half an inch on each side of the hole two brass uprights are fixed; they are forked at the top, and hold by friction a little ebonite rod with milled heads at each end.

One end of a silk fibre is attached anywhere on this rod; the other end is attached to the needle. The fibre may be a yard long if desired. The ebonite rod is then turned, winding the fibre round it until it (the fibre) is about the right length, and then the ebonite rod is slipped into its place.

The fibre then, if it is wound the right way round the rod, at once automatically centres itself, and by rotating the rod the needle can be set exactly. By this means a long suspension is secured, and, if it is desired, several rods and needles can be kept for different purposes—say, one with damper for general use, and a finely balanced astatic one for delicate testing, and a ballistic needle for condenser work. When the instrument has to be carried about a great deal spare needles, ready suspended, can be kept and be put in in a minute at any time should an acci-

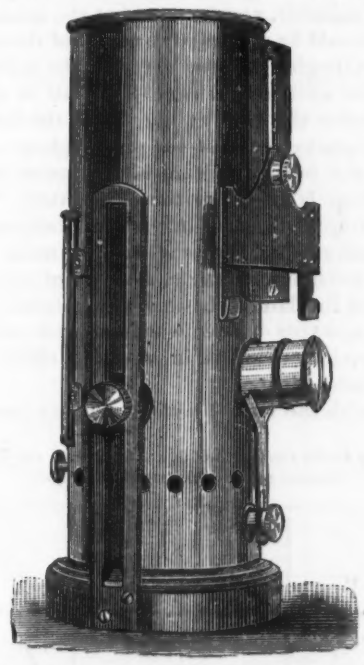


FIG. 3.—A NEW REFLECTING GALVANOMETER.

dent happen. If the suspension of a needle does break it is often at a critical moment when time is important. To replace it is, as usually suspended, as a rule, a long and tedious job. Much valuable time may therefore be sometimes saved by the use of a suspension of this character. It will readily be seen that attaching a new fibre is a very simple and short operation as compared with that necessary with the ordinary type of instrument. The needle itself consists of a stiff aluminium wire carrying the magnets and mirror.

For all ordinary testing work I prefer to bend the lower end of the aluminium wire round into a loop and flatten it out. This makes an excellent damper; it is sufficient to prevent long swinging and annoying vibrations without rendering the instrument dead and sluggish. This damper works in a little glass jar, fixed in the base of the instrument. The jar has its edges turned over to prevent the liquid being spilled when carried about. It is, of course, easy to add a second pair of coils on the same principles as the two in the instrument before you, should it be desired, but a constant of 1 degree deflection with 1 volt through 1,000 megohms can easily be got with a single pair of coils, which is more than sufficient for most purposes.

* Paper read before the Physical Society, March 10, 1888.

In using reflecting galvanometers a lamp and scale are required. All who have had experience in working with such instruments know that there is often as much trouble with the lamp and scale as with the galvanometer.

In the lamp and scale I have here I have tried, while

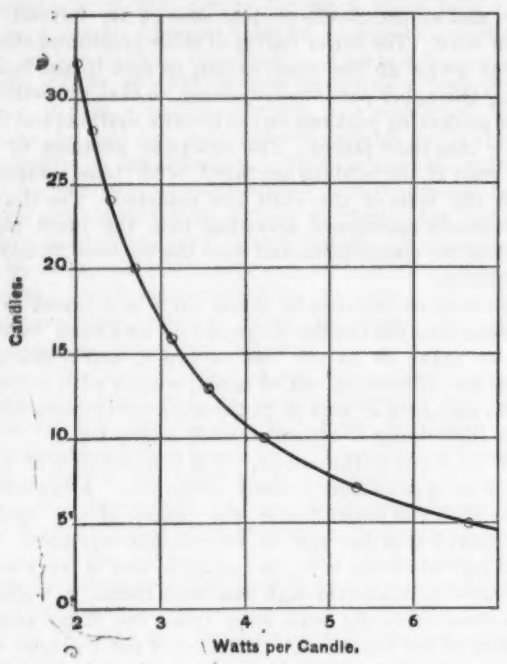


Fig. 1.

Curve showing lives of equally good lamps, burned at different efficiencies.

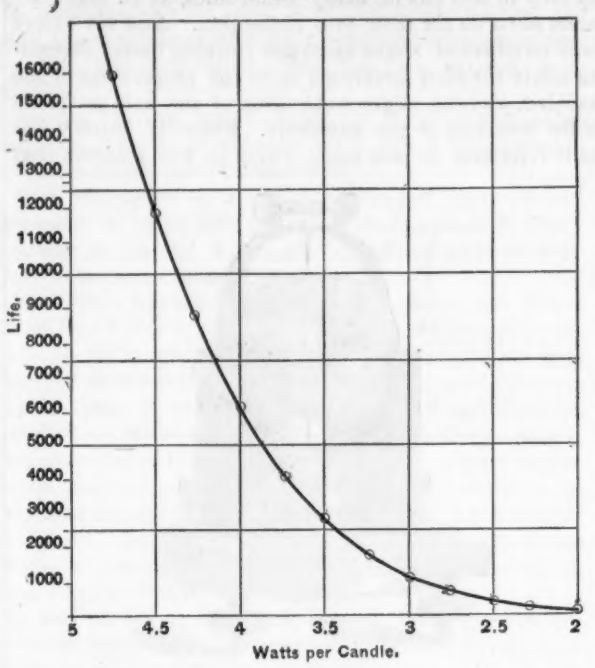


Fig. 2.

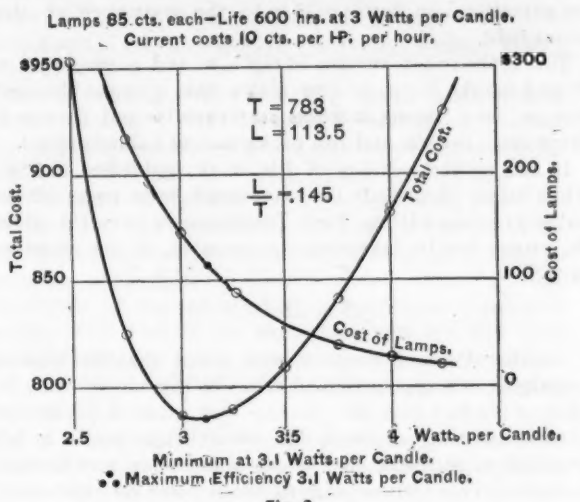


Fig. 3.

FIGS. 1, 2, 3.—THE MAXIMUM EFFICIENCY OF INCANDESCENT LAMPS.

light produced by it from the energy of the heat produced. Then the ratio of the energy of the light to the electrical energy required by the lamp will be a correct expression for the efficiency of the lamp, and we will have to find some other word to designate the watts per candle. In this paper the word efficiency is used in its ordinary improper sense to denote the watts per candle required by a lamp when producing a given amount of light.

The efficiency of a lamp varies with its candle power. The curve, Fig. 1, shows the rate of this variation for a particular lamp. At 5 candles this lamp has an efficiency of 6.7 watts per candle; at 10 candles it is 4.2 watts per candle, and at 20 candles it is 2.66 watts per candle.

Any statement regarding the efficiency of a lamp must, therefore, be accompanied by a statement of the candle power at which it has the stated efficiency; without this it is meaningless. There is nothing in an incandescent lamp itself that fixes its proper efficiency or in any way indicates what it is. The lamp from which the curve, Fig. 1, was determined has, within the limits of the curve, any efficiency between 2 and 7 watts per candle. Thus, by simply changing the candle power of the lamp, we can operate it at any efficiency we choose, and get as much or as little light per watt as we choose.

In commercial practice the candle power of lamps is always marked on them and their efficiency at this candle power is stated; but even this is not a proper index to the value of the lamp or to its proper efficiency. Experience has shown that lamps are almost universally run above their normal rating; lamps rated at 4.5 watts per candle are usually run at from 3.5 to 4 watts per candle, and in order to make lamps that will stand the strain of being run above their rated capacity, it is necessary to rate them considerably below the efficiency at which they will give the best results under ordinary circumstances.

Lamps have been made and sold in England which have a very high rated efficiency, but parties buying these lamps are told that they will get very much more satisfactory results if they run the lamp *below their rated capacity*. So we see that some lamps are rated above their capacity and some are rated below, and the rated efficiency of a lamp is not always the best efficiency at which to run it. How, then, are we to determine the efficiency at which a lamp will give the best results? It is this question which I will attempt to answer.

The term "maximum efficiency" of a lamp, as used in the title of this paper, does not mean the highest efficiency at which a lamp can be operated, but the efficiency at which the best results are produced by the lamp: or more accurately, *the efficiency at which the cost of operating the lamp is a minimum.*

Taken in this latter sense, the maximum efficiency of a lamp is not its highest efficiency. As we increase the candle power of a lamp its efficiency increases; consequently, by running the lamp high enough we can make its efficiency so high that very little power is required to produce a given amount of light, and the cost of the power to produce the light is very small. But, while the efficiency of the lamp increases, its life decreases, and if we run a lamp

The Maximum Efficiency of Incandescent Lamps.*

BY JOHN W. HOWELL.

The word efficiency, when applied to an incandescent lamp, is used to designate the amount of energy required by the lamp for the production of a given amount of light;

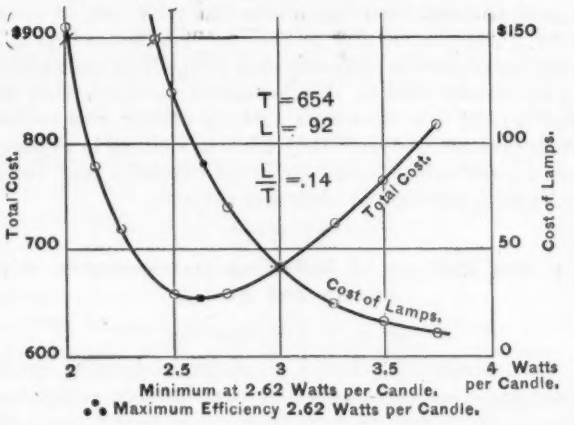


FIG. 7.

thus we say that a given lamp has an efficiency of 3 watts per candle, at 16 candles, meaning, that to produce an illumination of 16 candles we must supply the lamp with 48 watts.

The word efficiency, when applied to a prime mover or to any piece of apparatus that changes energy from one form to another, or which transmits or utilizes energy, rather less than is required for the ordinary pattern of lamp alone.

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The word efficiency, when applied to a prime mover or to any piece of apparatus that changes energy from one form to another, or which transmits or utilizes energy, has a well defined meaning, and is used to represent the ratio of the energy of the useful effect produced by the apparatus, to the energy necessarily supplied to the apparatus to enable it to produce that effect.

An incandescent lamp transforms electrical energy into heat and light, so the use of the word efficiency to denote the watts per candle required by the lamp is not a proper one. To denote properly the efficiency of an incandescent lamp we must be able to separate the energy of the

* A paper read before the American Institute of Electrical Engineers, April 10, 1888.

provided for raising or lowering the scale by itself, which is often convenient.

For carrying about or putting on one side a box is arranged to take both galvanometer and lamp, with room for shunts and other accessories. The size of this case is

securing the maximum efficiency, to reduce the whole within as small a compass as possible. The lamp itself, Fig. 3, consists of a copper tube about 12 inches long and 4½ inches in diameter. The bottom of the tube forms the reservoir, the top portion acting as a screen. This tube is supported by guides at the sides attached to a metal base, and which permits of the lamp being moved up and down through a total range of 6 inches.

In order to fill the lamp easily, a funnel is provided in the top of the reservoir with a tube attached which reaches nearly to the bottom of the reservoir. In this way the lamp can be quickly and cleanly filled, and there is no need of a screw stopper to keep the paraffin from spilling or evaporating.

Most essential points in the construction of a lamp are that the longer axis of the flame and the axis of the lens or slot should coincide, and further that the intensest part of the flame should be opposite the centre of the lens. In this lamp, by prolonging the rod carrying the milled head for adjusting the wick and causing it to fall in a slot in the tube just below the door at the back, the longer axis of the flame is always kept in the proper place. Again, the height of the burner is carefully adjusted to be right when the lens is in a horizontal position. Further, to allow the lamp to be used in various positions and with different instruments, the lens tube is made adjustable through a considerable angle, its axis of rotation being the centre of the flame. In this way a beam of light can be thrown upwards or downwards, as well as in the horizontal direction. This is, in working, often a matter of great convenience.

For use with the lamp I have arranged a specially port-

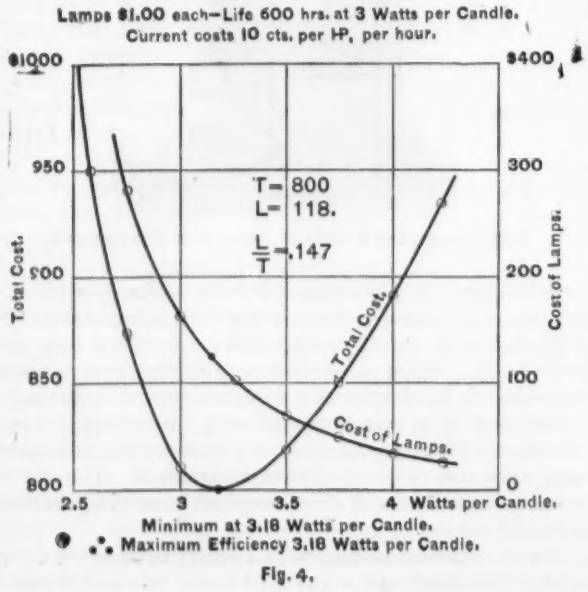

Fig. 4.

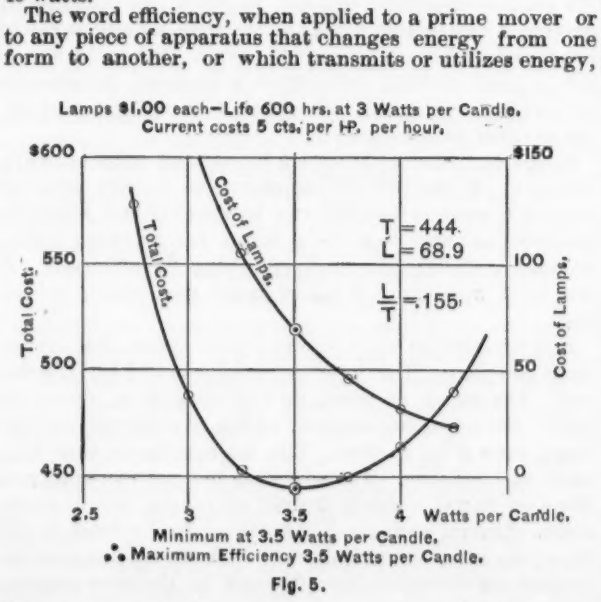

Fig. 5.

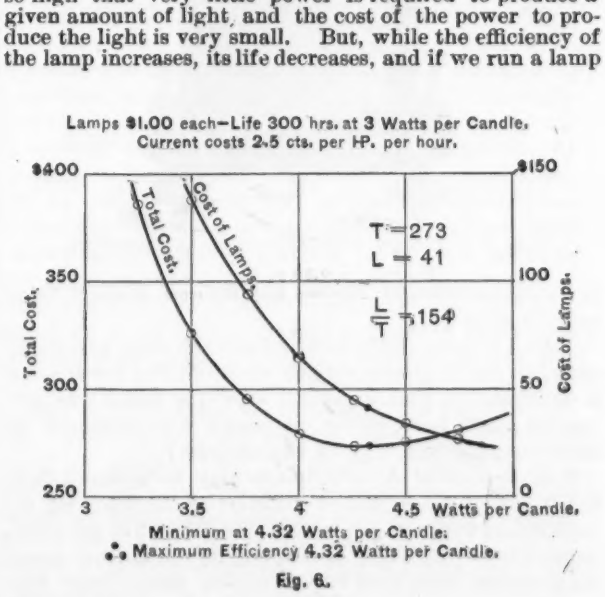

Fig. 6.

FIGS. 4, 5, 6.—THE MAXIMUM EFFICIENCY OF INCANDESCENT LAMPS.

able scale and shade. The scale itself consists of ½ a meter, divided into millimetres. It is mounted on a thin board, as usual; this board is attached to a shade of the same length by long hinges. The whole is then cut through the middle, and a hinge fixed on the back of the shade. By this means the whole folds into half its length. Guides are fixed on the back of the scale, which engage in a lock fixed to a cross piece on the front of the lamp, so that the scale slides easily backwards or forwards, and means are

at too high an efficiency the saving in the cost of power is more than balanced by the increased cost of lamp renewals.

To determine the maximum efficiency for lamps under given conditions, we must determine the efficiency at which the sum of the costs of power and lamps is a minimum, and in order to do this we must know the rate of variation of the life of a lamp with its efficiency.

The curve, Fig. 2, shows this rate of variation. This curve is the result of very carefully conducted experiments made by the Edison Company. These experiments

extended over five years and consumed a very large number of lamps. Its accuracy when applied to Edison lamps is beyond question; but our experiments with lamps having an artificial surface on the carbon, or "flashed" lamps as they are called, show that their rate of variation of life and efficiency follows a different curve.

This curve does not apply to individual lamps. If we take two Edison lamps and burn them at different efficiencies, their lives for these efficiencies will probably not be such as indicated by the curve, nor will they be proportioned to these indicated lives. But if we take one hundred lamps and burn them at one efficiency, and another hundred equally good lamps and burn them at another efficiency, the average lives of the two sets will be proportional to the lives indicated by the curve for these two efficiencies.

In order to determine at what efficiency the cost of operating lamps of a given quality under given conditions is a minimum we must calculate what this cost is at different efficiencies. To do this we consider the total cost of operating the lamps to be made up of two parts, viz., the cost of the *current* and the cost of the *lamps*. The cost of the current is made up of every expense incurred in operating the lamps, including materials consumed, labor, taxes, insurance, rent and every other expense incurred in operating the plant, except the cost of lamps. The cost of the lamps is an item by itself, and is the amount which the lamp has cost when it is put in use. This is a natural division of the total cost of operating a plant, since to produce light by incandesence all that is necessary is a lamp and current to operate it.

If, in any case, we know the cost of the current required to operate the lamps, the cost of the lamps, the quality of the lamps,—that is, the life they will give when burned at a given efficiency,—and the rate of variation of their life with efficiency, we can then calculate at what efficiency the cost of operating the lamps is a minimum, and this I call the maximum efficiency of those lamps.

The following examples show what this maximum efficiency is under varying conditions of the cost of lamps, the cost of current and the quality of the lamps. The cost of the lamps I have varied between 25 cents and $1.00 each. The cost of current varies between 2.5 cents and 10 cents per h. p. per hour. The quality of the lamps varies between 300 hours life at 3 watts per candle, and 2,400 hours life at 3 watts per candle.

In each of the following cases I have calculated the cost of operating 100 16 c. p. lamps 1,000 hours, at each of the

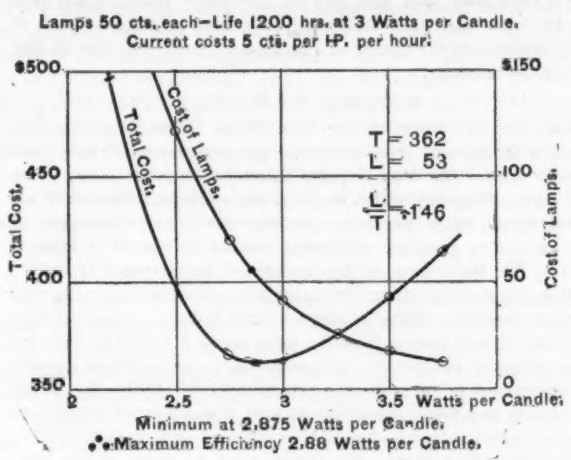

Fig. 8.

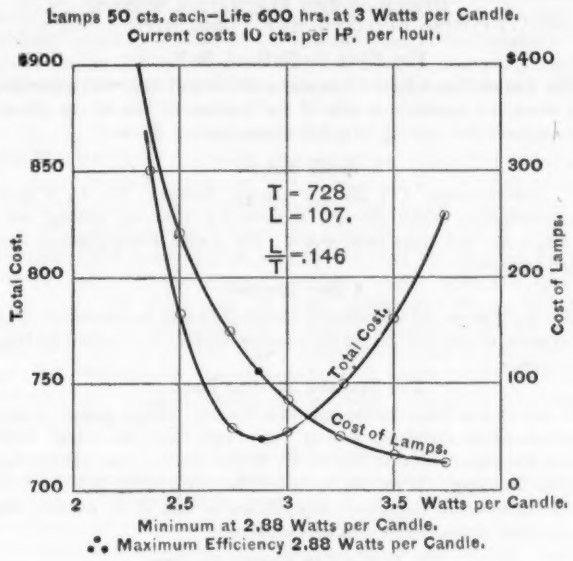

Fig. 9.

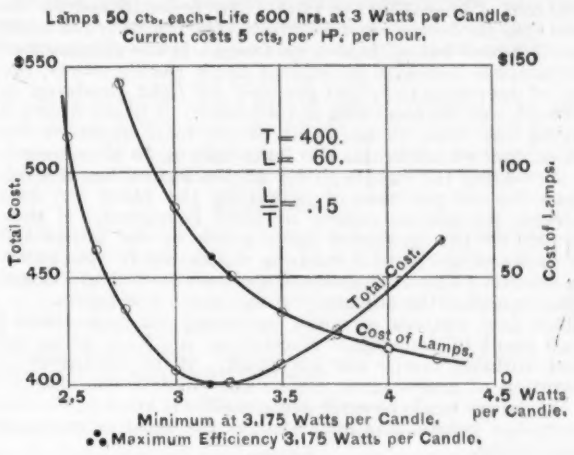

Fig. 10.

FIGS. 8, 9, 10.—THE MAXIMUM EFFICIENCY OF INCANDESCENT LAMPS.

cost of operating the lamps to be made up of two parts, viz., the cost of the *current* and the cost of the *lamps*. The cost of the current is made up of every expense incurred in operating the lamps, including materials consumed, labor, taxes, insurance, rent and every other expense incurred in operating the plant, except the cost of lamps. The cost of the lamps is an item by itself, and is the amount which the lamp has cost when it is put in use. This is a natural division of the total cost of operating a plant, since to produce light by incandesence all that is necessary is a lamp and current to operate it.

If, in any case, we know the cost of the current required to operate the lamps, the cost of the lamps, the quality of the lamps,—that is, the life they will give when burned at a given efficiency,—and the rate of variation of their life with efficiency, we can then calculate at what efficiency the cost of operating the lamps is a minimum, and this I call the maximum efficiency of those lamps.

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In each of the following cases I have calculated the cost of operating 100 16 c. p. lamps 1,000 hours, at each of the efficiencies comprised in the curve of total cost. These curves do not show the cost of running the same lamps at different efficiencies, but the cost of running equally good 16-candle lamps of the different efficiencies.

The first case we will consider is shown in the diagram Fig. 3. In this case the lamps are assumed to cost 85 cents each and to have a life of 600 hours at 3 watts per candle. The current is assumed to cost 10 cents per h. p. hour.

The cost of the current is determined from the following formula:

$$\text{Current cost} = \frac{\text{w. p. c.} \times 16 \times 100 \times 1{,}000 \times \text{cost of ct. per h. p. per hour}}{746}.$$

And the cost of lamps from this formula:

$$\text{Cost of lamps} = \frac{\text{cost of one lamp} \times 100 \times 1{,}000}{\text{Life at given efficiency}}.$$

The curve marked *total cost* shows the total cost of running 100 16 c. p. lamps 1,000 hours, the efficiencies of the lamps varying between 2.5 and 4.25 watts per candle. The efficiencies are shown by the vertical lines, referring to the scale at bottom. The value of the total cost at any point of the curve is shown by the horizontal line through the point, referring to the scale at the left of the diagram.

The lowest point of the curve shows the point where the total cost is lowest. This is the minimum cost of operating these lamps under the given conditions. The mark at the lowest point of the curve shows this minimum cost to be $783, and a vertical line through this point to the scale at bottom of the diagram shows that this total cost is a minimum when lamps having an efficiency of 3.1 watts per candle are used.

Thus the maximum efficiency of these lamps under the conditions assumed is 3.1 watts per candle.

The lamps considered in the case shown in Fig. 4 cost $1.00; all other conditions are the same as in the case shown in Fig. 3. This increases the total cost from $783 to $800, and necessitates using lamps of 3.18 watts per candle instead of 3.1, to make the cost of operating a minimum.

In the case shown in the diagram, Fig. 5, the current costs 5 cents per h. p. hour; the other conditions are the same as in the case assumed in Fig. 4. The minimum total cost in this case is $444, and to make this cost a minimum we must use lamps having an efficiency of 3.5 watts per candle.

In this case shown in Fig. 6 the lamps cost the same as in the last but are only half as good; the current costs just half as much as in the last case. The minimum total cost in this case is $273 and the maximum efficiency of the lamps is 4.32 watts per candle.

In the case shown in Fig. 7 the lamps cost 50 cents and have a life of 1,200 hours at 3 watts per candle. The current costs 10 cents per h. p. per hour. This is the cheapest and also the best lamp we have yet considered, but the current is expensive. In this case the minimum total cost is $654 and the maximum efficiency of the lamps is 2.62 watts per candle. In this case, Fig. 8, the current costs half as much as in the previous case, other conditions being the same. The minimum total cost is reduced from $654 to $362. The maximum efficiency in this case is 2.88 watts per candle. In Fig. 9 the current costs twice as much as in the previous case and the lamps are only half as good. The minimum total cost is doubled, but the maximum efficiency is the same as in the previous case.

In this case, Fig. 10, the current costs one-half of that assumed in the previous case, other conditions being the same. The minimum total cost is $400, and the maximum efficiency 3.175 watts per candle.

The curve, Fig. 11, illustrates the case of very cheap and very good lamps, with moderate cost of current. The minimum total cost is low, $294, while the lamps are run at the high efficiency of 2.38 watts per candle.

In the case shown in Fig. 12, the cost and quality of the lamps are the same as in the previous case, but the current costs twice as much. This increases the minimum total cost from $294 to $535, and raises the maximum efficiency to 2.14 watts per candle.

In the case, Fig. 13, the cost of lamps and the cost of current are the same as in the case shown in Fig. 11, but the lamps are only half as good. The minimum total cost is increased from $294 to $327 and the maximum efficiency is reduced from 2.38 to 2.62 watts per candle.

The first and plainest inference drawn from these curves is that the maximum efficiency of any given lamp is not a fixed one, but varies with conditions outside the lamp itself. Identical lamps operated under different conditions of cost of current must be burned at different efficiencies to make the cost of operation a minimum for the production of a given amount of light. In order to determine the maximum efficiency of lamps, therefore, we must know the quality of the lamps referred to some standard, the cost of the lamps to the consumer, and the cost of current under the actual conditions existing at the place where the lamps are to be used.

In the eleven cases shown in this paper the lamp of highest efficiency is obtained in the case shown in Fig. 12. This is a case where the lamps are very cheap and very good, and current is very expensive. The lamp having the lowest efficiency is obtained in the case shown in Fig. 6, in which the lamps are poor and high-priced and the current is very cheap.

There is a marked difference in the sharpness of these curves at the minimum points. An inspection will show that the sharpness of the bend in these curves depends upon the cost of the current, the curves in which the current costs 10 cents per h. p. per hour being the sharpest. Those in which the current costs 5 cents are next, and the one, Fig. 6, in which the current costs only 2½ cents per h. p. per hour, is very flat at the bottom or minimum point. In this comparison Fig. 7 is not considered, as it is drawn on a different scale from the others, and is not as sharp as it should be.

This indicates that the more expensive the power is, the more carefully must the lamp efficiencies be chosen. In Fig. 12, which shows the sharpest curve, a very slight variation in the efficiencies of the lamps makes a very great change in the total cost of operation.

In the case shown in Fig 6, in which the current is very cheap, we find that a very considerable change in the efficiency of the lamps used makes very little difference in the total cost or operation.

On each of the eleven diagrams two curves are drawn, one showing the total cost of operation, and the other showing the cost of lamps. On each of the curves showing the cost of lamps a point is marked which indicates the cost of the lamps when the total cost is a minimum. The letter T marked on each of the figures denotes the minimum total cost of operating the lamps under the given conditions. The letter L denotes the cost of the lamps when the total cost is a minimum; and the expression $\frac{L}{T}$ denotes the ratio of the cost of lamps when the total cost is a minimum, to the minimum total cost. An examination of all these curves shows that while the minimum total cost varies with each of the three quantities—price of lamps, quality of lamps and cost of current—nevertheless, *the total cost is always a minimum when the cost of lamps is about 14.5 or 15 per cent. of the total cost of operation.*

This figure varies somewhat in the different examples considered, but the variation seems to follow no law. In Figs. 6 and 12 which show the highest and lowest efficiency lamps the figures are 15.1 per cent. and 15.4 per cent. respectively.

The steepness of the curve showing the cost of lamps, and the difficulty of determining the exact minimum point of a curve which has been drawn by inaccurate methods makes it difficult to get the cost of lamps accurately when total cost is a minimum. These curves and values are given just as they were determined, and no effort has been made to bring the results into closer agreement, as could readily have been done. I consider the variation shown by these curves to indicate closely enough that this ratio of cost of lamps to total cost at the minimum point is nearly, if not quite, constant and that its value is between .145 and .15.

This establishes a very simple law for determining whether or not lamps are being operated at their maximum efficiency; for if they are, the lamp bills will be

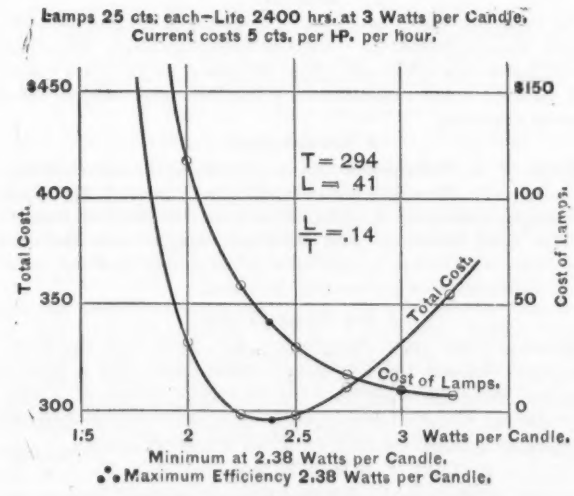


Fig. 11.

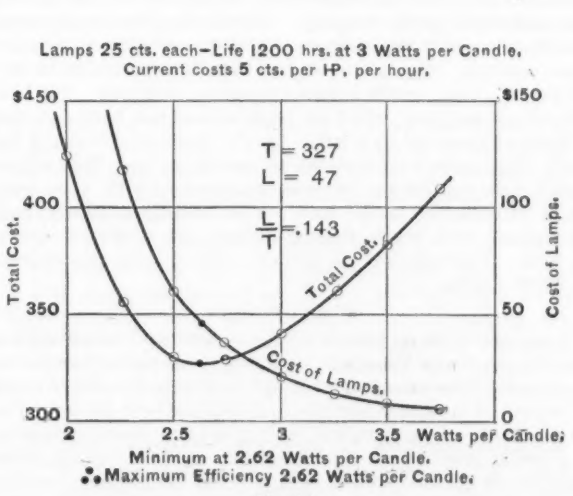


Fig. 13.

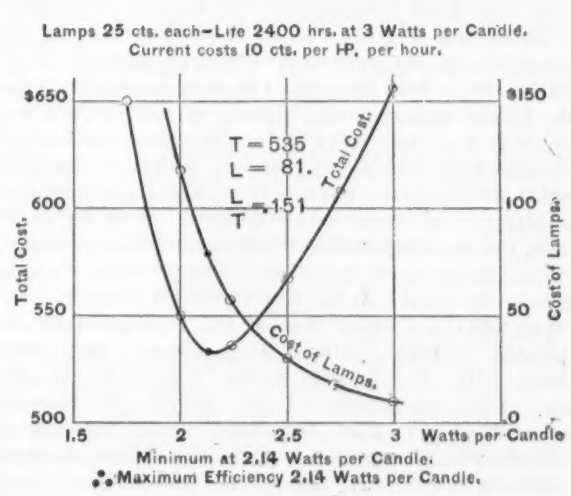


Fig. 12.

FIGS. 11, 12, 13.—THE MAXIMUM EFFICIENCY OF INCANDESCENT LAMPS.

about 15 per cent. of the total operating expenses of the plant. If the lamp bills are more than 15 per cent. of the total operating expenses the lamps are being burned above their maximum efficiency, and lower efficiency lamps should be obtained. If, on the other hand, the lamp bills are less than 15 per cent. of the total expenses of the plant the lamps are being burned below their maximum efficiency and higher efficiency lamps would reduce the cost of operating the plant. Where fuel is high priced, or where other causes operate to make the cost of generating current high, it is specially important to use lamps of the maximum efficiency, for we have seen from the above curves that where the cost of current is high the use of lamps whose efficiency is a little above or below the maximum efficiency attainable under the conditions of operation, makes a very marked increase in the operating expenses of the plant.

If in any plant the lamp bills are only 10 per cent. of the total expenses, then *increasing the efficiency of the lamps by increasing their candle power does not diminish the total cost of operating the plant.* In order to reduce the total cost *the lamps must be replaced by lamps of the same candle power but of higher efficiency.* If the efficiency of the lamps is increased by raising their candle power, the cost of operating the plant *per unit of light produced* is reduced, but the total cost is increased. A plant which is paying less than 15 per cent. of its total expenses for lamps, and which brings the lamp bills up to 15 per cent. by increasing the candle power of the lamps does not decrease the cost per lamp of operating the plant but *does* decrease the cost per candle of light furnished. If they are paid for the increased light given by the lamps the efficiency of the plant is made a maximum for the existing conditions; but if they are not paid for the additional light furnished the efficiency of the plant is reduced.

This law enables any one operating an incandescent lamp plant to determine whether or not he is using the most suitable lamps for his plant. If the conditions of operation of a new plant are all known, and the quality of the lamps made by any lamp maker is known, we can determine before starting what is the most economical lamp to use.

An Electric Exchange.

As a result of the recent meetings of underwriters and electric light men in Boston, on the subject of rules for installation, etc., an electric exchange has now been organized in that city. The active membership is limited to those who are actually employed in the field of electric light work in the New England States. The officers are: President, P. H. Alexander; secretary, H. B. Cram, and a board of referees, composed of the above with R. Amory, G. W. Davenport and F. Ridlon. The first meeting is to be held in April, when the Board will report a plan under which licenses may be granted to employés of electric light installations and those engaged in the wiring and installation of electric light plants. The other meetings are to be held in July, October and January. The fees are limited to $3 per annum, the expenses being limited by the kind tender of the use of the rooms of the Boston Electric Club for the Exchange meetings. A large number of gentlemen have already enrolled themselves as members, and the movement is well under way.

A Telegraphers' Dinner.

The blizzard that visited this city a few weeks ago upset or postponed many plans and social engagements, among them being a dinner that had been arranged for by the New York Telegraphers' Aid Society. The disappointment was a great one to many, especially as the ladies of the society were to have been present; and it has been decided to hold the dinner as early as possible in the fall. In the meantime the suggestion was thrown out that it would not be a bad idea for the officers and leading members of the various co-operative bodies in the telegraphic fraternity to have a little social meeting, and the thing was no sooner said than done. With Mr. C. P. Bruch, the secretary of the Telegraphers' Mutual Benefit Association, in the chair, a dinner was given on Wednesday evening, April 4, at the Knickerbocker Cottage, Sixth avenue, and the evening was of the most pleasant and enjoyable nature. After the cigars had been lighted, Mr. G. Irving spoke for the Aid Society, and was followed by Mr. E. F. Howell, who told of the good and solid work being done by the Building Association, which already has a business amounting to $100,000. Mr. W. L. Ives delivered a very humorous speech to the toast of the Mutual Benefit Association, and Mr. T. O'Reilly spoke for the famous Brotherhood. Mr. G. W. Walcott then sang "Simon the Cellarer," and was followed by Mr. T. C. Martin, as to the benefits derived from movements founded upon self help and co-operation, instanced by the remarkable success obtained with them among telegraphers. Mr. Walcott and Mr. McAneeny then sang "The Larboard Watch," and Mr. J. B. Taltavall spoke in a felicitous manner of the growth shown by the various organizations and of the pride that all telegraphers felt in them. Mr. D. B. Mitchell then made a few pithy remarks in behalf of the Gold & Stock Insurance Association, and was followed by Messrs. Walcott and McGowan. Mr. O'Reilly then showed that he could sing as well as speak, and addresses were also made by Messrs. Beatty and L. C. Jones. Mr. Walcott next gave "The Sword of Bunker Hill." The chairman kept matters going throughout with great skill, neatness and bonhomie, and it was with regret at having to part that the company joined in singing "Auld Lang Syne." Among other well-known gentlemen present were Messrs. E. T. Barberie, J. M. Moffatt, J. Brandt, R. G. Stephenson, T. A. Brooks, J. H. Montgomery, H. A. Moody, C. L. Chase, Theo. Betzel and M. M. Davis. It was resolved before separating to spend another such evening at no very distant date, and the fixing of the time and place was left in the hands of the chairman.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
168-177 Potter Building, New York, April 9, 1888.

Fire Alarm for Cortland, N. Y.

The Union Fire Alarm Company, 145 Broadway, was awarded last week, by unanimous vote of the trustees of the above place, the contract for putting in a fire alarm system there.

Small Motors.

G. Zimmerman, 171 Halsey street, Newark, N. J., is now manufacturing small electric motors for running sewing machines, fans, and other light work. He is also doing general construction work.

A New Dynamo.

Mr. E. Wilcox, 211 Mulberry street, Newark, is manufacturing a dynamo which will be on the market shortly for electro-plating purposes.

The Equitable Building Plant.

In my recent notes on the splendid United States plant in the Equitable Life Building, it was remarked that the wires were under the supervision of Mr. G. H. Pride, who is the electrician for the building. It should be stated, however, that this part of the work is under the direct supervision of Mr. J. R. Strong, the electrician of the United States Company.

The Empire City Electric Company.

This bustling, progressive company of 15 Dey street has elected to its presidency Mr. O. E. Madden, so well known in connection with the commercial development of the telephone and storage battery in this country. Mr. John C. Gulick, who was formerly president and is now vice-president, is a prominent lawyer; the secretary is Mr. E. W. Carritt. The company were successful, it will be remembered, in introducing the dynamo gas lighter when they went into business, and they continue to make it a specialty, finding there is a steady and brisk sale for it. They are already oversold on their new and improved iron and wood box bells. They are, I believe, at present the only concern making iron box bells in imitation of the finer varieties of woods. Among their other specialties may be mentioned their Leclanché batteries and their "Empire City" push buttons in wood and bronze in a great variety of styles.

New Size of Universal Milling Machine.

I had an opportunity of seeing this week the new No. 2 Universal milling machine, manufactured by E. E. Garvin & Co., of this city. This size is a mean between the large and small size generally used. It is small enough to be handy, and well proportioned for doing heavy work with accuracy and speed. The extra heavy arm, together with the outboard centre, are especially designed for rigidly supporting the arbor while making heavy cuts far out from the face of machine. This outboard centre is a new application of an old style centre, and consists of a tool steel plug driven into the yoke. A ¾-inch straight hole in the inner end serves as a bearing for the arbor; it is hardened and ground out a standard size, being split through the centre, and it allows taking out the wear from the top. Provision is made for end thrust, and for the expansion of the arbor. This style of centre has lately been adopted on all the milling machines made by this company. The dividing head is the standard style made by this company, and has been fully described in your columns. The action of the feed is independent of the angle of the table, which ranges 45 degrees each way. The feed is by worm and gear, which are made of steel and hardened, and is thrown in and out by a small handle projecting through the block. The gears for spirals can be quickly set up. The adjustments, both vertical and traverse, are arranged with dials reading in thousandths of an inch. This machine is solidly built throughout, with ample bearing surface and means for taking up wear. The weight of the machine with friction countershaft is 2,500 pounds.

Blizzard Echoes.

A number of young women in the book-keeping department of the Western Union Telegraph Company who were prevented by the blizzard from attending at the office March 12 and 13 found at the end of the month that their salaries had been docked. Employés in other departments of the big building found themselves in a similar predicament, but on making application to the proper superior officers succeeded in being allowed full pay on account of the extraordinary character of the cause of their detention. This the young lady book-keepers failed to do, and when they found that they were not supplied with what they had not taken the trouble to ask for some of them put their grievance in the newspapers.

Augustus Noll & Co.

are now carrying on their business as wiring contractors at 15 E. 16th street. They have issued a tasteful little pamphlet, in which they give their views and ideas on the subject of the necessities of the case as regards good wiring work, and the remarks therein contained are weighty and forcible. The concern have now installed conductors for over 50,000 lamps, and, therefore, have good warrant for their claims to patronage. They also have a notable list of references. The concern operate under the Edison authorization.

The Hall Telephone Company

of this city are now introducing their mechanical telephone, and have already found a large number of patrons, whose testimonials show them to be pleased with the working of the instruments. The lines are equipped, if desired, with magneto call bells.

The Safety Electric Construction Company,

of 41-43 Wall street, have the record of having built and equipped four electric railroads during the year 1887, on the Daft system. They are prepared to carry out contracts for electric, cable or steam roads, and to furnish all the necessary material, such as rails, spikes, cars, wheels, fare boxes, registers, etc.

Subway Stock.

Ex-Senator Gibbs entered into an agreement with Edward Lauterbach last April by which, it is alleged, he offered to do what he could towards having an act then pending before the Senate, beneficial to the Consolidated Telegraph and Electrical Subway Company, passed. For his services he was to receive 200 shares of the company's stock within thirty days after the enactment. The bill passed the Senate, and Gibbs assigned his right to fifty-five of the shares to Julio Merzbacher, who demanded the stock of Mr. Lauterbach, but did not receive it. He began an action in the Supreme Court for its recovery. Mr. Lauterbach put in an answer, in which he stated that he made an agreement with Mr. Gibbs, but asserts, however, that the stock was not to be delivered to Gibbs until it was fully paid. This, he says, has not yet been done, and will not be for some time. Until that time the stock will not be turned over to him. Judge Barrett, of the Supreme Court, has denied a motion to place the case on the short-cause calendar.

A Brokerage Fee Wanted.

I find the following in the New York *World* for April 4: "Nelson G. Green, who demands as remuneration for three weeks' work for the Van Depoele Electric Manufacturing Company a sum of money which that company alleges to be out of all reason, had to listen yesterday, in Supreme Court, Chambers, to some extremely personal and disagreeable criticisms of himself made by Mr. Robertson, of the law firm of Robertson & Harmon. Mr. Robertson alleges that Green, by false pretenses, asserting that he was a wealthy capitalist and a retired lawyer, representing a syndicate of well-known business men, secured from the Van Depoele Company in Chicago authorization to secure them moneys and purchasers of stock to the extent of $1,320,000. Mr. Green was said to be a very plausible man and, it was alleged, acted with a sharp confederate who had served a five-year term in Sing Sing for forgery. The names Mr. Green used as those of his associates were William Steinway, J. Q. Preble (whom he called President of the Ninth National Bank of this city) and a Mr. Hull. All of these gentlemen have repudiated Green and any business connection with him in a series of affidavits. Green went to Chicago and persuaded a William Clarke and Gen. Stiles, President of the Van Depoele Company, to engage him as broker for this transaction. He borrowed, it is alleged, $700 for expenses, and immediately proceeded to Brooklyn and represented himself to E. W. Bliss, a well-known capitalist, and tried to induce him to purchase the stock. Mr. Bliss went with William Clarke, Greene and the latter's alleged confederate to Chicago. There was a row on the train between the alleged confederate and Green, and just before the party reached Chicago, Green, it is charged, approached William Clarke with a proposition for a side issue in which he and Clarke were to swindle Gen. Stiles out of a large amount of money. Mr. Clarke indignantly repudiated this and fisticuffs were barely averted. Mr. Bliss, smelling a row, immediately withdrew. Green then returned to this city and brought suit for his fees. Col. George Bliss, Green's counsel, has made the counter argument.

W. T. H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
48 Congress Street, Boston, April 9, 1888.

Personals.

Mr. Frank W. Harrington, of the Western Electric Company, of Chicago, was in Boston last week.

Removal.

The Campbell Electrical Supply Company, of Boston, the well-known manufacturers of "Vulcan" wire—formerly known as the Campbell line wire—are about to lease a larger factory, and will increase their manufacturing facilities and enlarge their force of employés.

A New Catalogue.

Messrs. F. E. Pettingell & Co., proprietors of the electrical supply house recently established in Boston, have issued to the trade a catalogue containing in alphabetical form the various lines of electric light, telephone and telegraph supplies that the firm keep in stock. Dealers in supplies referred to will find the catalogue mentioned a handy book of reference.

A New Telegraph Line.

Recent advices from Farmington, Me., state that the North Franklin Telegraph and Telephone Company has voted to build a telegraph line from the town of Strong to the village of Eustis, same State. This will open up telegraphic communication to and from the great sporting resorts of the Dead River region.

A Busy Company.

At the works of the Eastern Electric Cable Company on Hampshire street, Boston, the braiding machines have been kept busy night and day for some time past in vain efforts to keep pace with the rapid increase in orders for "Clark" wire.

Proposed Conduit System for Boston.

The committee of the whole board of aldermen of Boston, which has been considering the order giving the exclusive right of the streets to H. C. Cobb, R. M. Pulsifer and others, for the purpose of constructing conduits for electric wires, etc., will submit its report to the board of aldermen at an early day. It is said that the report will be one recommending that the petitioners' request be granted.

Dinner of the "Tech" Society of '87.

The annual reunion and dinner of the Society of '87, Massachusetts Institute of Technology, was held at the Hotel Thorndike on the evening of March 31, and was a great success, over 30 members being present, and telegrams and letters were read from various parts of the States, Territories and Canada bearing witness of the interest of absent members in the meeting. After the repast, remarks were made by H. D. Sears, of the Thomson-Houston Company; F. E. Shepard, government inspector of marine boilers; H. C. Spaulding of the Thomson-Houston Motor Company; B. C. Lane and others. Papers of interest by H. A. Wilcox and S. Sturges were read, and F. C. Bullard furnished music

and accompaniments for singing. The meeting broke up with rousing cheers for '87 and Technology. The officers of the society are: T. W. Sprague, president; G. W. Davenport, vice-president; G. F. Curtiss, secretary; W. L. Harris, treasurer; Messrs. H. C. Spaulding, G. W. Patterson and F. E. Shepard, executive committee.

Colon, Central America.

The Thomson-Houston system, which was installed last season at Colon, has proved so successful that the people of that city are generally adopting the lights, and a plant, both steam and electric, of double the original capacity, is now being shipped; they use Armington & Sims engines.

Malden, Mass.

The Malden, Mass., Electric Company have been, for some time past, arranging for a large increase of their plant, as the electric lights there have been so successful as to necessitate the addition of a large quantity of lighting apparatus, both for arc and incandescent lighting. Since the new management, under Mr. H. A. Royce, treasurer of the company, assumed control, the policy of the company has been one of energy and enterprise. In the increase of the company's business, there will be added a large number of Thomson-Houston arc lights, and the adoption of the alternating system of the same company. The contract for the steam plant has been awarded to the Jarvis Engineering Company, of Boston, and the increase calls for about 500 h. p. of boilers and engines, the latter of the Armington & Sims type. The entire plant is planned for further increase, and the piping, etc., will be now placed for about double the above capacity; the piping to be furnished by Wm. H. Gallison, of this city.

Martha's Vineyard Cables.

"It is proposed to lay a cable this spring between Pasque Island and Gay Head, Martha's Vineyard," said W. D. Wright of the United States army to a *Herald* reporter recently. "This will give better and more reliable telegraphic service, which will prove extremely valuable to those interested in marine matters. This location for the cable has been selected because the water is much deeper there, and vessels in anchoring are less likely to foul it. The one now in use has been broken three times by vessels catching it in their anchors. It may be understood what the advantage of having a signal station at Gay Head is, when I state that statistics show that between 50,000 and 60,000 vessels go past that point every year. These could be reported to the marine exchanges. It is probable that a signal station will be established at that point in time. Gen. Greely, chief of the signal service, originated the idea of laying this cable in the place selected. Congress has appropriated the necessary money for its laying, and it will be down inside of three months, probably.

The Curtis Damper Regulator.

An improvement which has been made in the well-known Curtis damper regulator, manufactured by the Curtis Regulator Company, of Boston, has been called to my attention. In this device the principles contained in the Curtis pressure regulator have been applied to the movement of a damper in the flue of a steam boiler so as to obtain great uniformity of boiler pressure, many of them closing and opening the damper with a variation of boiler pressure of less than one pound and maintaining the pressure with very slight variation. In the apparatus steam is brought in a one-quarter inch pipe from the boiler to the chamber surrounding the valve and this pressure is also carried through the side pipe to the diaphragm. By turning down on a handle a spring is compressed, loading the diaphram with any given weight so as to hold the valve on its seat. When the boiler pressure in the valve chamber rises high enough to lift this load the valve opens about $\frac{1}{100}$ of an inch, admitting steam to the top of a piston, pushing it down to the bottom of its stroke and overhauling the chain which closes the damper. The improvement consists in an arrangement by which the piston in starting back relieves the pressure on a spindle, permitting the valve to open again and providing just the needful pressure in the cylinder to hold the damper closed until the boiler pressure falling, say, one-half pound has no longer power to open the valve, and the weight opens the damper.

A Handsome Official Compliment.

The following, taken from the annual report of the Selectmen of Southbridge, Mass., speaks for itself, and reflects great credit not only on the electric company of that town, but on Mr. T. T. Robinson in particular. "At the annual meeting in April it was voted to adopt the system of electric lighting for our streets, and the Selectmen were instructed to contract for the same, not to exceed 40 arc lights. The Board consulted the agents of the different electric light companies with a view of ascertaining the best and most economical. After a thorough examination we adopted the Thomson-Houston system, and think we were fortunate in our selection. We contracted for 40 arc lights and located the same as equally as possible between the two villages, in accordance with the vote of the town. We think the Southbridge Electric Company is to be commended for the thorough and serviceable establishment of its plant; the neat and tidy appearance of its straight and painted poles, all of which appear to be in keeping with the general appearance of our beautiful town, and do not tend to mar and make unsightly, but rather present a business-like aspect, which demonstrates that we are abreast of the times."

The Mather Electric Company.

The Mather Company, of Manchester, Conn., through its Boston agents (Messrs. Claflin & Kimball) is now installing a 350 incandescent light plant in the new hotel (Ottawa House), Portland, Maine. W. I. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 South Tenth Street, Philadelphia, Pa., April 7, 1888.

City Lighting.

In his annual message to Councils, Mayor Fitler has this to say about the Electrical Department: "This bureau is well organized and efficient in all its appointments. Chief Walker, in his report to the Director of the Department of Public Safety, thoroughly explains and discusses its workings. I suggest that we continue as rapidly as possible the extension of the city's fire telegraph; that appropriations for the extension of the city's electric underground service be made, and that as quickly as possible all wires be placed under the surface, or, if this last cannot be done, that the tower system be carefully examined, as by this means the wires can be placed so far above ground as not to interfere in case of fire. I call special attention, however, to the system of underground arc lighting introduced by this bureau early in 1886, and extended in 1887, and which to-day is in successful operation." The reports submitted to the Mayor show that 354 electric lights have been maintained during the year at a cost of $87,975.

The Post Office Plant.

The government inspectors who were sent here to inspect the mammoth electric light plant in the Post Office building in this city have concluded their work, and as a result the plant has been accepted from the contractors—the United States Electric Lighting Company. Most of the fixtures used in the installation were furnished by the Horn, Branner & Forsyth Manufacturing Company, the well known manufacturers of combination fixtures.

Partrick & Carter.

The above firm, of 114 South Second street, have just issued a new catalogue and price list, which exemplifies very well both the growth of electrical industries and of this business in particular. The catalogue, which now runs a length of about 70 pages, is liberally illustrated, and it is supplemented by another that deals specially with annunciators, burglar alarm bells, gas lighting, etc. As this old house has been established since 1867, it may be said to have attained its majority, and it is entitled to remark, as it does, that "our many years' experience as manufacturers and dealers has been productive of many improvements that could not suggest themselves to those unfamiliar with the requirements of the trade."

An Electric Display at Sea.

The passengers of the American Line steamship "British Princess," which arrived in port last Tuesday from Liverpool, were treated to electrical displays of various kinds on the trip. On March 29 balls of fire hung from the yardarms and rigging, constantly changing color, and lighting up the whole ship. On Monday the sea was a mass of phosphorescent light, and in the distance looked as if on fire. E. W. E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, April 7, 1888.

Bidwell Electric Railway.

It is reported that the directors of the Bidwell Electric Railway and Manufacturing Company have determined to begin the construction of a surface road in Valparaiso, Ind., May 1.

Chicago Lighting.

At a meeting of the City Council Friday night of this week $30,000 was appropriated for the extension of the city electric light plant.

California.

The Oakland (Cal.) Electric Light and Motor Company are about to put in a plant of the Indianapolis Jenney electric light system to be used in connection with their present plant, entirely for the night circuit. The Pasadena Electric Light and Power Company is putting in a 75 h. p. boiler and Corliss engine.

Kansas, Mo.

New franchises for electric light systems are being applied for in Kansas City.

An Electrical Publishing Company.

March 29 the Secretary of State at Springfield issued licenses of incorporation to the following: The Electrical Publishing Company of Chicago; capital, $50,000; incorporators, C. S. Burton, E. F. Burton, and F. W. Parker. Also, the Rockford Electric Power Company filed a certificate recording an increase of capital stock from $30,000 to $70,000.

Miscellaneous.

The Matchless Metal Polish Company report a sale of Tripoline to the Brush Electric Light Company, of Lafayette, Ind., during the past week, besides shipments to the Electric Light Company, of Columbus, Ohio, the Edison Electric Light Company at Lancaster, Pa., and others.

The Electrical Construction Company.

The Electrical Construction Company are about to move into larger and more commodious quarters at 175 Randolph street during the coming week, their business having increased to such an extent as to make it necessary. Their facilities for manufacturing will be increased by the addition of new lathes. They will also carry a stock of house goods.

New Corporations.

The Secretary of State at Springfield, April 2, issued an incorporation license to the Joliet Electric Light Company, of Joliet. Capital stock, $50,000. Incorporators: Lewis E. Ingalls, John Stephen, Horace S. Smith. Also, April 3, to the Wheeler Reflector Company of Chicago. Capital stock, $100,000. Incorporators: William A. Toles, Willard L. Gillam and George E. Plumb.

Joplin, Mo.

The Joplin Electric Light Company is to increase its plant by 50 full arc lamps which it has just ordered of the Thomson-Houston Company.

The Van Depoele Company.

The Van Depoele Company are very busy just now completing the construction of the electric railways for which they had contracts before the recent sale of their railway patents, etc., to the Thomson-Houston Company, and they are filling many recent contracts for electric lighting for saw-mills, etc., throughout the west. At their factory they have increased the working force by 25 men. They expect to have the Electric Light and Power Company's plant at Helena, Ark., which consists of 60 arc lamps, running next week.

Mr. W. A. Stiles, of the Van Depoele Electric Light Company, will shortly assume the general management of the company including the sales department and the local agencies, which he will establish in all the important cities of the United States. Mr. Stiles has already appointed Captain J. H. Andrews agent for the Southwest, with headquarters at Dennison, Tex., and George L. Colgate, of Milwaukee, agent for Wisconsin. Messrs. Jerome S Busk and E. D. Stiles will act as special traveling agents, with headquarters at Chicago. The company are now busy perfecting their new incandescent system, which they propose to place upon the market in about 60 days. The system will embrace some entirely new features which, it is claimed, possesses special points of excellence. The company just received a telegram from the Dennison Electric Light and Power Company, at Dennison, Tex., stating that its station consisting of 100 lights had been burned to the ground. The same telegram contained an order for one 60 and also one 40 arc light dynamo, which is a pretty fair specimen of Texas enterprise.

The Chicago Electric Club.

The Board of Managers of the Chicago Electric Club held a meeting April 4 at the club parlors, at which the feasibility of moving into larger and better quarters was considered. A committee consisting of Messrs. W. J. Buckley, Frank Stewart, W. A. Kreidler and J. P. Barrett was appointed to look into the matter and report at the next meeting of the Board, April 12. The advisability of raising the yearly dues was also discussed.

The Electric Supply Company.

Mr. Fred. De Land, of the Electric Supply Company, has just returned from an extended trip throughout the South and West, and reports that the prospects are very promising for increased business in the electrical line.

A Novel Easter Egg.

A special feature of the Easter exercises on Sunday last at Christ Church was an Easter egg filled with flowers and lighted by electricity. The egg was about five feet in length and covered with paper and cotton batting. The lamps were banked in various colored flowers on the inside, and when the egg was opened showed up handsomely. The electric part was furnished by the Northwestern Accumulator Company.

A "New" Lamp Maker.

A well known electrician told me a pretty good story the other day, the truth of which he vouches for. He in company with another gentleman was recently visiting a place where dynamos were manufactured. The Superintendent, who was also, I believe, the electrician of the establishment, showed them through the factory, explaining the principle of the machine made by his company and talking on various electrical subjects. In the course of the conversation, Mr. Superintendent was asked whose lamp they were using. He replied he was not quite sure on that point, but (examining the lamp) thought it must be Mr. Volt's, as his name was on the lamp!

The City Western Electric Plant.

The city of Chicago is at last in a fair way to solve the difficult problem of how to prevent the exasperating delays heretofore experienced by the people from the swinging of the bridges to permit the passage of vessels up or down the river during the season of navigation. With this in view, they have recently installed an electric light plant, consisting of over 100 2,000 candle-power lamps, distributed on the different bridges and at intervals on both sides of the river. This plant is now in operation, and the results are highly satisfactory. The lights have been distributed with great care and the entire stretch of the river lighted is as easily navigable on the darkest night as at noonday. It is expected that a large percentage of the vessel movements will be made during the night time, thus largely relieving the traffic over the bridges during the busiest hours of the day. The plant is located on city property at the corner of Clinton and Washington streets, and consists of four 30-light dynamos, driven by a 125 horse-power Buckeye engine. The 18 miles of circuit required is all underground and the greater part is laid with Patterson cable, one section being laid with Kerite. The Western Electric system is used and the installation reflects great credit on this company. The fact that Prof. Barrett, city electrician, has entire charge of the plant, is a guarantee that Chicago can boast of an electric light station second to none.

Col. S. G. Lynch, broker, 146 La Salle street, furnishes quotations upon telephone stock as follows:

Bell of Mo.	$160@	$165	Iowa Union	$26@	$27
Central Union	47@	48	Michigan	78@	80
Chicago	375@	400	Missouri and Kansas	70@	72
Colorado	19@	21	Rocky Mountain Bell	40@	45
Cumberland	65@	68	Wisconsin	108@	109
Great Southern	35@	40			

E. L. P.

SOUTHERN NOTES.

TYLER, Tex., March 29, 1888.

The Westinghouse central station constructed for the Tyler Electric Light Company by Frank S. Marr (contractor) was started on Feb. 16, and the steady glow of the incandescents has since been creeping from store to store, until now all the business houses—which heretofore used kerosene or naphtha—are lighted as brilliantly as any similar place in our large Northern cities. The station is nearly a mile from the centre of the city, and is located near the planing mills of the Tyler Lumber Company. Steam is supplied to both institutions from the same boilers, as the planing mill engine stops before the heavy part of the lighting comes on. The fuel used is refuse lumber, shavings, etc. The commercial system is wired for 1,300 sixteen c. p. lamps. One 650-light alternating dynamo only is now in operation, but as its capacity is nearly taken another will soon be added. Apart from the commercial system, the Light Company have a ten years' contract with the city for street lights, one hundred of which are now wired. The street lights are of twenty-five c. p. arranged on the new Westinghouse series plan, and the circuits at present have an aggregate length of about eight miles of No. 12 B. W. G. wire. All the line wire in the entire system is water proof. The station is arranged after the usual admirable manner characteristic of the Marr Company's work. Among the new features of the switchboard are compensating voltmeters, which do away with complicated and costly pressure wires, and a new arrangement for switching dynamos in and off the different circuits instantaneously. All conductors in the station carrying high potentials are of "Okonite" insulation covered with molding, so it is impossible for any one to get a shock except at the brushes of the machine. The station is finished inside with varnished hard pine and

is the wonder and admiration of all the natives, as are also the taut wires on the poles and neat arrangements of the converters. The workmanlike way in which the inside wiring has been executed is likewise said to be in striking contrast with most work done heretofore by electric light companies in the State. The stockholders here, who have seen many other systems in operation, express themselves as more than pleased with their selection of the Westinghouse alternating on account of its steadiness, brilliancy, ease of regulation and low cost. The officers of the company are Messrs. A. L. Clarke, F. S. Dilley and J. D. Moody. L.

EL PASO, Tex., March 27, 1888.

The electric light company in this city has a Brush outfit, with a capacity of 85 arc lights. It is at present running 30 arcs and 350 incandescents. It has had a very spirited contest with the gas company in its efforts to secure the lighting of the city, and came out victorious. On Friday evening next it will be offered a contract for at least 15 arcs, and probably 25, as a beginning. El Paso is a stirring town of over 10,000, and is of the progressive order of Southern cities. The company is alive to its opportunities, and already is busy with the idea of putting up a new plant of a capacity for at least 150 arcs and 1,500 to 2,000 incandescents. A. W. D.

PACIFIC SLOPE NOTES.

SAN FRANCISCO, Cal., March 20, 1888.

San Jose.

The San Jose electric road had a car running on the 15th inst. The speed made was 12 miles an hour. Mr. Fisher, who put in the plant, had charge of the test. Everything worked satisfactorily. Another item from San Jose is that the local company has just obtained underground franchises.

Electric Lighting.

The State Prison at San Quentin has been lighted by electricity. The plant at Carson City was started up last week. The Coronado Beach Hotel Company is to build another large hotel on the beach, which will have an incandescent plant. Honolulu, Sandwich Islands, is to be lighted by electricity, and Christchurch and Wellington, New Zealand, are both asking for bids on plants. The Berkeley Electric Light Company, this State, started its plant on the 18th inst. to the accompaniment of music and a mass meeting of the citizens.

ENGLISH NOTES.

LONDON, March 28, 1888.

Fire Office Rules.

It will probably be remembered that only a few months ago there was a great stir amongst electrical engineers here with regard to the proposed formation of a new electrical association which should devote its energies entirely to commercial and practical affairs. After a great deal of talk the scheme was allowed to fall through; but now once more the annoyance and confusion which arises from the non-existence of any such association is prominently brought forward by the existing state of affairs with regard to the fire office rules. Whilst the sole existing society, as a body of electricians, has been very properly engaged in the consideration of the effects of electricity upon polarized light, and while the telegraph engineers are studying Robertson's writing telegraph, the electrical contractors are writing to the papers proposing to call a meeting especially to consider this burning question of fire office rules. Meanwhile, as I mentioned in my last letter, the subject will shortly be dealt with in a paper by Mr. Preece, chairman of the committee of the Society of Telegraph Engineers and Electricans which was appointed some years ago to deal with the subject. But this does not satisfy practical men. They say, and not unreasonably, that this is a matter which should be settled between the parties immediately concerned, namely, the fire insurance companies and the electrical contractors, and there are ominous grumblings about "professorial dictation, and the interference of busybodies, etc." However, the men who talk and write in this way may at least have the grace to wait until they have seen the new rules to be issued by the society before finally condemning them. I had an opportunity of seeing them last night. My opinion is that although they can scarcely do much good, they will certainly do little positive harm, as they consist chiefly of a mass of generalities which, after all, practically leave the matter to be settled by everybody as he may think fit. Then comes in the real difficulty, because it is quite certain that the fire insurance companies will not be content with vague recommendations of this character, and therefore every company will in time have its own independent set of rules, and the net result will be chaos. Of course, if the association of electrical engineers had been in existence, a body qualified to speak on behalf of the trade could have settled the matter in consultation with the fire offices in a very short time.

Strain and Stress in Di-Electrics.

At the meeting of the Society of Telegraph Engineers and Electricians, on Thursday last, we had, for a change, a purely theoretical and experimental paper by Prof. Rücker and Mr. Vernon Boys. The subject dealt in was that of the optical effects produced by stress and strain in the di-electric. The experiments were of an extremely beautiful character, and some of the effects showed the most wonderful combinations of color. Until recently it has been held that the well-known experiment of Dr. Herr (of which those exhibited by Prof. Rücker were merely extensions) had proved that a charged di-electric assumed a quasi-crystalline structure, but Prof. Rücker showed that this interpretation lies open to some doubt, and that the effects may, after all, be due merely to stress and strain, acting at right angles in the medium.

Writing Telegraphs.

At the conclusion of the lecture, Robertson's writing telegraph was exhibited by Mr. Johnson. This instrument is, I believe, well known in the United States, and therefore I need not give you any description. But though it was on view at the recent American Exhibition, and was described at the time in the technical journals of this country, it appears to have been known to a comparatively small number of electrical men here, and great interest was taken in its performance. Had it preceded the invention of the telephone, no doubt this apparatus would have attained a practical importance which now, unfortunately, appears to be denied it.

Thunder and Lightning.

At the annual meeting of the Royal Meteorological Society, which has just been held, the President, Dr. Marcet, delivered an interesting address upon Atmospheric Electricity. Although it cannot be said that he added much to our knowledge of the subject, one experiment which he showed and which was of a very simple, but highly interesting character, was this: By means of a lens he threw upon the screen a magnified image of an electric spark from an induction machine, which then appeared to have all the characteristics of a lightning flash. After Dr. Marcet's paper Mr. G. Symons read a very amusing note "On the Non-Existence of Thunderbolts, with an account of searches after them, illustrated by specimens." The "thunderbolts" exhibited included a cannon-ball, some lumps of coal, several clinkers, half a brick and various objects of a similar character which had been treasured by credulous people, who were firmly persuaded that they had veritably fallen from the heavens. In one case a laborer saw a tree shattered by a lightning flash and found a deep hole scooped out in the earth at its roots. He proceeded to dig into this hole, and discovered what proved to be a very fine specimen of an ancient bronze implement. Now in this case, and also that of the cannon ball, which came to light under exactly similar circumstances, it is clear that the presence of the metallic body in the soil has something to do with determining the path of the flash. It therefore occurs to me that it might sometimes prove "good business" to dig up a hole scooped by lightning, because one might just as well find a pot of gold as a cannon ball or a celt. (N. B.—I should be pleased to hear privately from any of your readers who may happen to have an opportunity of verifying this observation.) As I mentioned in my last, the same society has just been holding an exhibition of objects of interest connected with atmospheric electricity, including a fine collection of old instruments which were once in use at the Royal Observatories at Kew and at Greenwich. There was also an extensive display of photographs of lightning flashes, but probably the most remarkable article exhibited consisted of an entire suit of clothes which had been stripped from the body of a man by a lightning flash and torn almost to rags. The man escaped unhurt, although his nerves (as may easily be supposed) were in rather a shattered condition. This incident occurred about ten years ago, and the clothes were lent for exhibition by the Royal College of Surgeons.

Portraits of English Electricians.

A weekly journal called *Invention* has published this week a supplement containing portraits of fifty-five prominent electricians of this country, together with brief biographies of each. The portraits are in most cases very well done.

Electricity in Mines.

In the South Wales coal fields several collieries have recently adopted electricity not only for lighting above and below ground, but also for signaling and blasting. At one colliery, in the Rhondda Valley, the adoption of electrical signaling has enabled the management to increase the output of coal by no less than 50 tons per day. In this colliery also the whole of the upper surface is illuminated by arc lamps, while experiments are being made below with the Edison-Swan Company's portable mining lamp. This, as you are perhaps aware, consists of a small secondary battery combined with an incandescent lamp about 2 c. p. The dynamo current from the surface is also used for blasting, with results of a highly successful character. Not only does this method reduce to a minimum the necessary risk attendant upon blasting in coal mines, but also what is perhaps most important of all, it has been so fortunate as to meet with the approval of the workmen.

THE TELEGRAPH.

Bucket-Shops in Canada.—At Ottawa, on March 28, in the Senate, the government introduced a bill providing that persons engaged in making bucket-shop transactions shall be accounted guilty of a misdemeanor, and liable to imprisonment for a term not exceeding five years and a fine not exceeding $5,000, and that frequenters of bucket-shops shall be liable to imprisonment for one year.

Multiple Morse Keys.—Mr. W. B. Broadax, of San Bernardino, Cal., writes us: "In THE ELECTRICAL WORLD of March 17 was an article upon 'Simultaneous Transmission by a Single Morse Key,' describing the same and crediting the idea to Mr. David Kunhardt, of Aachen, Germany. I have had the same principle in operation for several months in this office, and thus I claim the idea to be original with me, as it doubtless is with Mr. Kunhardt. The invention is, however, I learn, an old one, and its practicability has often been pointed out in relation to press and 'C. N. D.' circuits in large offices."

Paternal Legislation Not Wanted.—There is no more reason for asking the national government to play the part of big brother in this telegraph matter than to invoke government regulation for any other species of business. Doubtless, Congress could fix rates for telegraphing, but it has no business to do anything of the kind. Better the highest rates that greed can charge than government paternalism and intermeddling. The government has enough to do to manage national affairs and maintain the conditions of liberty, without saddling it with the duty of looking out for all our private interests, and seeing to it that the telegraph companies, the butchers and the grocers, do not charge us too high for what they furnish.—*Com-Advr.*

Kiernan's Assignment Set Aside.—Judge O'Brien of the Supreme Court has set aside the assignment of John J. Kiernan, of the news agency, to Patrick Gleason, Mayor of Long Island City, as fraudulent. In February, 1887, Kiernan assigned to Gleason all his interest in the firms of John J. Kiernan & Co. and Frank, Kiernan & Co. The Bank of Montreal got a judgment against Kiernan on Nov. 4, 1887, for $5,178.20. This it was unable to collect, and application was made to have the assignment set aside as fraudulent and given without consideration, and for the purpose of preventing creditors from collecting. It was averred that Kiernan's interest in Kiernan & Co. was worth $20,000 a year, and in Frank, Kiernan & Co. $12,000. Judge O'Brien has also granted an injunction restraining Gleason and Kiernan from interfering with Kiernan's income from these firms, and says that a receiver will be appointed to receive such income for the benefit of creditors.

THE TELEPHONE.

Paris to Marseilles.—Long-distance telephone service is to be established between Paris and Marseilles, and will be ready by July.

The Knickerbocker Telephone Company, of New York, has been incorporated by H. E. Townsend, C. L. Cammann and Gustav Franck, with a capital stock of $125,000.

Middletown, Conn.—The trouble as to adjacent circuits between the local telephone and electric light companies has been amicably settled, and the wires are to be more widely separated.

Nova Scotia.—The Nova Scotia Telephone Company (limited) now has over 700 telephones in use in the province and has a number of long distance lines forming an important network. One line runs between Halifax and Pictou, a distance of 130 miles. The company is now seeking for powers to operate in the province of New Brunswick. It has bought out the Bell Company, but has to secure a new franchise from the legislature. Mr. A. A. Knudson will begin work on the extensions there as soon as spring opens.

A Rehearing Improbable.—A special dispatch from Washington of April 4 says: As to the generally prevailing impression that there is more or less probability of a rehearing of the Bell telephone cases by the United States Supreme Court, Justice Miller says that such action is extremely improbable. In the twenty-five years he has been on the Supreme bench there have been but ten rehearings. When, as in the telephone case, the bench is nearly equally divided, every point bearing on the case in the most remote degree is thoroughly canvassed, and nothing in any way bearing on the case is passed over. But when the bench is unanimous, or nearly so, a decision may perhaps be reached without so thorough a canvass of all phases of the subject, and some minor point may be overlooked and a rehearing granted, but this is a very rare circumstance.

Chicago.—A special dispatch from Chicago of April 7 says: The City Council has passed an ordinance granting the Cushman Telephone Company the right to lay wires and operate a telephone system in Chicago, thus breaking the monopoly of the Bell Company in this city. The charter provides that all wires within a mile north and two miles west and south of the City Hall shall be laid underground. Within the city limits as they existed July 1, 1887, the wires are to be put underground in six years. The prices are to be $95 for the first year and $85 for each succeeding year, except where a contract is made for three years, when the rental per annum shall be $75. The public offices are to be supplied with telephones free of charge and telephones for police and fire alarm systems shall be rented to the city for not more than $5 per annum. The Bell Company now charges from $100 to $130 per year.

The Bonta Telephone.—Mr. J. W. Bonta, who has a make-and-break telephone, says he is ready to enter the field at once. During the year that his patent has existed he has devoted himself to organization. He says he has laid out 56 districts east of the Rocky Mountains, and that an organization has been completed in this city, Philadelphia, New Jersey and part of Pennsylvania. The company which he has formed is to be known as the American National Telephone Company. There are some well known names in the directorate, among them Edward A. Quintard, Granville P. Hawes, W. H. Starbuck, Walter M. Jackson, F. B. Thurber, J. H. Johnston and Gen. W. W. H. Davis. Granville P. Hawes is President of the company and Dering Fosdick is Secretary. The members of the Advisory Board include H. P. De Graaf, of the Bowery Savings Bank; John A. Stewart, of the United States Trust Company; J. Q. Adams, of the State Banking Department; J. Bushnell, of the Standard Oil Company; Samuel H. Wallace, of the Pennsylvania Railroad Company, Bank Superintendent Willis S. Paine and Herman Yerkes.

THE ELECTRIC LIGHT.

Waco, Tex.—The Waco Gas Company will operate the local Jenney plant.

Grafton, W. Va.—The Grafton Gas Company is to put in a 60-arc light plant.

Montgomery, Ala.—The Adams Cotton Mills will put in an electric light plant.

Beaumont, Tex.—An electric light plant is to be put in by Thomas & Gorman.

Horton, Kan.—The Horton Electric Light Company has been started and will put in a plant.

Great Falls, N. H.—The Great Falls Manufacturing Company will put in an electric light plant.

Cleburne, Tex.—The Cleburne Electric Light Company are now receiving the machinery for their plant.

Lynchburg, Va.—The Lynchburg Incandescent Electric Light Company is to remove and enlarge its plant.

Key West, Fla.—The Key West Gas Company are now making arrangements to put in their electric light plant.

Augusta, Ga.—The Augusta cotton factory will put in an electric light plant this summer to cost about $10,000.

Ionia, Mich.—The Ionia Electric Company has been formed by J. E. Jurt and others, with a capital stock of $25,000.

Aurora, Ill.—The Aurora Electric Light Company has been incorporated by W. Meredith and others with a capital stock of $15,000.

Indian Railways.—The Government of India has set aside 15,000 rupees to lighting by electricity some of the trains on the Madras Railway.

Baltimore, Md.—The mayor is to appoint a committee to inquire as to the cost of establishing and maintaining gas and electric light plants.

Revere, Mass.—The North Shore Electric Company, of Revere, Mass., has been formed by C. H. Thayer and others, with a capital stock of $50,000.

Oldtown, Me.—Isolated plants have been put in by M. L. Jordan in his spool timber mill and by T. M. Chapman & Son in their wood-working factory.

Dexter, Me.—A fire occurred on March 29 in Eldridge Brothers' sash and blind factory, by which the adjoining electric light plant was damaged $300.

A Mather Plant.—The Mather Electric Light Company has sold a 500-light incandescent plant to the Church Green Electric Light Company for central station work.

Batesville, Ark.—The Batesville Water and Electric Light Company has been organized, with a capital stock of $25,000, and with J. F. Allen as president, to put in an electric light plant, etc.

Brooklyn, N. Y.—The bill now before the State Legislature authorizing the Edison Electric Light Company to open the streets of Brooklyn and lay wires for electric lighting has the support of Mayor Chapin.

Great Falls, N. H.—An electric lighting company has been organized at Great Falls, N. H., with a capital stock of $15,000. Mr. H. W. Burgett has been awarded the contract for lighting the town for the term of ten years.

Kissimmee, Fla.—The South Florida Electric Light, Power and Motor Company, with a capital stock of $20,000, has been incorporated at Kissimmee, by C. F. Sugg, J. M. Bowling, J. King and C. Swayne, to erect an electric light plant.

A Western Electric Building.—The Western Electric Company will put up, from designs by Cyrus L. W. Eidlitz, a nine story factory, 82 by 119 feet, on the southeast corner of Greenwich and Thames streets, this city. The cost will reach $200,000.

Little Rock, Ark.—With regard to the proposed city plant the Baltimore *Manufacturers' Record* says: The Board of Public Works contemplate erecting an electric plant to light the city, and are receiving bids. The capacity is to be 90 arc lights of 2,000 candle-power each. Twenty-seven thousand dollars have been appropriated for the plant by the council.

Orange, Mass.—A local paper says: "The engine at the electric light station was started up for the first time Wednesday morning, and everything found satisfactory. The grand illumination of all the lights took place Saturday night, and they are now a part of the community. The Thomson-Houston Company has shown pluck and we wish it success."

Canandaigua, N. Y.—The Canandaigua Electric Light Company is using the Excelsior system. It has four 30-light arc machines, and two engines, one of 35 and the other 60 h. p. The circuits have a length of about 25 miles, and carry about 110 lights. The service is so well liked that it would probably now be difficult to place many more lights, everybody using them who has any necessity. Mr. M. D. Munger is the general manager.

San Bernardino, Cal.—The electric light company at San Bernardino is to put in the Indianapolis Jenney incandescent system, and the arc circuits will also be utilized for motors. The company has a splendid water-power near the city, and it is quite probable some of the street railroads will adopt electricity. The Arrow Head Hot Springs, situated on the mountain side, about 1,000 feet above the city, and distant seven miles, has an isolated incandescent plant running about 300 Jenney lamps. At night the effect is very fine. The power is derived from a turbine.

Amsterdam, Holland, is to have a central electric light station for direct incandescent lighting. The peculiarity of the plant will be the use of two very large slow speed dynamos with automatic potential regulation. Each machine making 100 revolutions per minute is to feed 2,400 lamps of 16 c. p., and is capable of taking care of a load of 4,000 lamps. Compound condensing engines, directly connected with the dynamos, will be put in. The work will be done by the Helios Company, of Ehrenfeld and Cologne. The dynamos were designed by Mr. H. Coerper.

Westinghouse Stock.—A special dispatch in the New York *Tribune* from Pittsburgh, of April 5, says: Speaking of the Westinghouse Electric Company, The *Chronicle Telegraph* to-day says: "It is stated that next week holders of the original shares will get three new shares, or in the proportion of four to one, and those having the second issue two new ones, or three for one. In addition to this a quarterly dividend of 1½ per cent. in cash, the first, will be declared on the entire capital stock for $5,000,000. The entire amount of treasury stock has been taken at par by insiders, it being understood that George Westinghouse, Jr., was among the largest subscribers.

Limitation of Patents.—A hearing was had last week before Judge Wallace, in the U. S. Circuit Court of the Southern District of New York, in the suit of the Edison Electric Light Company against the United States Electric Lighting Company. The question was as to the effect of foreign patents in limiting the period of the Edison patents 223,898, 227,229, 265,777, 263,140, 265,311 and 251,554. Argument in behalf of the Edison Company as to the non-effect of foreign patents or their terms was presented by W. M. Evarts, C. A. Seward, J. C. Tomlinson and R. N. Dyer, and on the other side by Wetmore, Betts, Atterbury & Betts, and Duncan, Curtis and Page.

Greenville, Mo.—The Greenville Electric Light and Power Company, of which note has already been made, has a capital stock of $25,000, all of which has been subscribed. It has purchased from the Van Depoele Company two 40 arc light machines, and from the Edison United Manufacturing Company one 375 incandescent light machine. It has also purchased from the Taylor Manufacturing Company, of Chambersburg, Pa., a 140 h. p. Beck engine and two 70 h. p. boilers. The company hopes to have all of this plant in position and running by the middle of May. All the arc lights have been subscribed for, and the demand for the incandescents promises to be even greater. Mr. G. E. Billingsley is the president of the company, Mr. C. M. Williams the vice-president, and Mr. H. P. Hawkins secretary.

APPLICATIONS OF POWER.

Erie, Pa.—The Erie City Passenger Railway Company is adopting electricity.

Omaha, Neb.—The Omaha Motor Railway Company will probably adopt electricity.

Nashville, Tenn.—The McGavock & Mount Vernon road is to be operated by electricity.

The Daft Railway System.—The Daft Company reports several new roads to equip with its system.

Richmond, Va.—An electric railway is projected to run from Richmond along the Chesterfield turnpike.

Easton, Pa.—The short Daft road at Easton has been such a success that an early extension of it is proposed.

Flushing, N. Y.—The Flushing & College Point road, 4 miles long, is to be operated by electricity before the end of May.

Sacramento, Cal.—The Central Street Railroad Company has a capital stock of $50,000, and proposes to put in an electric equipment.

Los Angeles, Cal.—The Jefferson street electric line is now in successful operation by the Los Angeles Electric Street Railroad Company.

Plum Island, Mass.—It is stated that the Plum Island Street Railway Company proposes to operate its road by electricity this year.

Little Rock, Ark.—The City Electric Railway Company, of Little Rock, has three eight-wheel cars made by the Brill Company, of Philadelphia.

Franklin, O.—The local company is changing its name to the Franklin Electric Railway, Light and Power Company, to indicate its new departure in adopting electricity.

Meriden, Conn.—The Meriden Horse Railroad Company is about to adopt electricity. The road will be five miles long, with twelve cars. It is understood that the contract has been taken by the Daft Company.

Baltimore, Md.—The Baltimore Traction Company has been incorporated by M. A. McCormick, C. D. Fisher, E. Hambleton, J. L. McLane and others with a capital stock of $5,000, to handle electric, cable and other roads.

Indianapolis, Ind.—An electric railway company has been formed to build a road to Crown Hill, Mapleton and Broad Ripple. The organizers are T. P. Haughey, W. A. Ketcham, T. H. Spaun, E. H. Eldridge and F. Maus.

Asbury Park, N. J.—Four miles of track are being added to the Daft road at Asbury Park, and 8 new cars have been ordered from the J. G. Brill Co., of Philadelphia. The road will then have 20 cars, 10 closed and 10 open.

Clayton, Mo.—The St. Louis County Street Railroad Company has a capital stock of $15,000. The president is M. B. Greensfelder; vice-president, H. Chomeau; secretary, W. C. Wengler. It is proposed to use electricity.

St. Joseph, Mo.—The Union Street Railroad Company, which has for some time past been running a Sprague car, has now contracted for converting its whole line into an electric road, using the same system. Work has already begun.

Richmond, Va.—On Sunday, April 1, the Sprague road put in at Richmond for the Union Passenger Railroad Company carried 9,000 passengers. Each car in use traveled 87 miles. The sum of $430 was taken in fares during the day.

Chattanooga, Tenn.—The Electric Street Railroad Company, in which F. Gates is interested, objects to the requirement that the tracks must be at the sides of the streets. It is claimed that the curves would be too sharp.—*St. Ry. Jour.*

Peoria, Ill.—The Rapid Transit Railroad Company, which was recently incorporated by M. Kingman, F. J. Miller, and J. M. Rice, with a capital stock of $100,000, intends building an electric road 5 miles long, and will begin work very soon.

Harrisburg, Pa.—The J. G. Brill Company, of Philadelphia, have just finished a number of cars for the Sprague road at Harrisburg. The conductors, etc., have been put up, and we understand that headway is being made with the steam plant.

Wilkesbarre, Pa.—The Sprague road at Wilkesbarre is about ready. The station equipment comprises two Edison machines, each equal to operating six full sized cars, and two 60 h. p. engines. The plant will go into operation using only one engine.

St. Catherines, Ont.—The Van Depoele road, put in for the St. Catherines, Merritton & Thorold Street Railway Company, has been a great success, and is to be extended 3 miles. This road, it will be remembered, has its dynamos driven by water power.

The National Electric Railroad Company has been incorporated at Pittsburgh with a capital stock of $100,000, by J. W. Dalzell, W. J. McElroy, G. B. Hill and T. J. McTighe. Property has been purchased for a factory and the company will soon be in active operation.

Columbus, O.—The Columbus Electric Railway has two 27-foot cars running. The Short series system is used, with an 18 h. p. Brush motor under each car. The road belongs to the Columbus Street Railway Company, who will run it to the Centennial Grounds during the summer.

Long Branch, N. J.—The new electric road will run from the ocean through Broadway to the Monmouth Park race track, near Eatontown. There will also be a branch from the main line in Broadway through Third avenue to the principal station of the New York & Long Branch Railroad, and another one through Washington street to the Branchport station.

Toledo, O.—Two electric roads are contemplated in Toledo, and one of them will be put in by a woman, Mrs. C. W. Daniels, who has obtained the support of a majority of the property holders along the line. This will use the Van Depoele system. A franchise has also been granted to Mr. A. Marsh to construct and run an electric road on Indiana and Washington avenues and other thoroughfares.

Baxter Motors.—Mr. T. McCoubray, Jr., the New York agent of the Baxter Company, reports an active demand for motors. The Backus Water Company, of Newark, N. J., have arranged to use the Baxter motor in that city, and are now putting in an installation of rotating ventilator fans so operated. Messrs. Liebmann Bros. & Owings, Brooklyn, are putting in a cash car system which is to be operated by Baxter motor. A one h. p. Baxter motor has been sold to Mr. J. Kitteringham for his Turkish bath-house in East Eighth street. It will run the pump for supplying the plunge bath with artesian water.

New York.—Mr. H. Anderson, counsel, and Mr. Stitt, superintendent, of the New York & Harlem Railway Company, appeared before the Board of Aldermen Committee on Railroads last week to ask permission to run the cars of their road by electric motors instead of horse power. They have the consent of the property holders on the line of Fourth avenue to the extent of nearly $10,000,000, or more than half the total value. The majority of the committee favor the plan and are expected so to report. This is the road which will use the ten Julien cars now being built by the Brill Company of Philadelphia. These cars will be 18 feet long and will be palace cars in every sense of the word, being finer than anything else of the kind ever built.

Pittsburgh, Pa.—The work of construction will begin at once on the East End Electric Railroad, which is to extend from Fifth avenue and Grant street to East Liberty. The estimated cost of laying the tracks and furnishing all the necessary materials to complete the road from Grant street to Thirty-third is $120,000, and no trouble is anticipated in procuring this amount, as residents along the route have expressed a willingness to take from $50,000 to $75,000 worth of the stock. Friends of the project say that it will be completed within a year. The intention is not to build to East Liberty at present. Overhead conduction will be used. The company will have the use of the Oakland cable line's tracks down Fifth avenue to Market street. This will bring them into competition with the Central passenger line, between which and the new company there is said to be considerable rivalry. Among the gentlemen who are interested in the enterprise are J. A. Henderson, W. A. Herron, J. N. McMillan, Prof. C. B. Wood and S. A. Duncan.—*St. Ry. Jour.*

PERSONALS.

Prof. George Forbes left this country for England on Saturday last by the German steamer. It is said he will return in the fall of the year.

Mr. F. A. M. Burrell has been admitted as a partner in the firm of Chas. A. Schieren & Co., the well-known manufacturers of belting for electric light and power plants.

Prof. A. E. Dolbear, of Tufts College, is to deliver an address on "Recent Advance in Electrical Science" next July, at Newport, R. I., before the American Institute of Instruction.

Mr. A. L. Rohrer and Mr. E. Blake gave an illustrated lecture entertainment a few evenings ago at Newton Centre, Mass., in behalf of the local Improvement Association. The addresses, experiments, etc., were well received by a large audience.

Mr. W. F. Swift, the secretary of the Brush Electric Company, has, we hear, been spending a month in Texas, and has had the opportunity of "giving considerable information in connection with electricity to parties who have previously known very little about the subject."

Mr. T. F. Hunter, who has had six years association with the New York office of the Electrical Supply Company of Ansonia, has secured, under the firm name of T. F. Hunter & Co., the New York agency for that company, and will carry on business at 37 Church street from May 1.

Prof. W. D. Marks has been named by the Court of Common Pleas in Philadelphia as one of the experts who are to make a full and detailed inspection of the Keely motor within the next thirty days. Prof. Marks is a leading authority on dynamic engineering and the selection is wise.

Mr. William Baxter, Jr., the inventor of the Baxter motor, is, it may be mentioned, the son of the late William Baxter, who designed the well-known Baxter engine, and who, as mentioned in Mr. Pope's *Century* article this month, was specially employed at the Speedwell Works, as a boy of fifteen, in building the first Morse telegraphic apparatus, being picked out for the work because of his ingenuity and mechanical ability.

Mr. Maurice B. Flynn gets a salvo from the Richmond correspondent of the New York *Herald*, on account of his electrical enterprises in the Southern city. The writer seems to hunt around for flaws and points to pick at, and even criticises the electric road because it is said to be Flynn's; but he admits that the "defects will no doubt be remedied," and that "the cars are constantly filled with passengers. The people seem never to tire of riding in them, while the old cars drawn by mules are almost deserted."

Mr. A. H. Parker, who has been connected for some months past with the Austin Water, Light and Power Company, has received the apointment as State agent, or representative, in Texas for the Brush Electric Company of Cleveland, O., with headquarters at Dallas, and in future will have charge of that company's entire business in Texas. The appointment is a most excellent one. Mr. Parker is a young gentleman of fine business qualities, excellent address, and will make friends wherever he goes. The *Dispatch* congratulates him as well as the company.—*Austin Dispatch.*

Dr. Park Benjamin has in the April *Forum* an admirable article on "The Dawn of Electricity," in which he takes the opportunity to point out how much modern electricity is indebted to the work and genius of Dr. William Gilbert, the author of *De Magnete.* Dr. Benjamin is well known as an enthusiastic and indefatigable student of early electrical literature, some of the finest and rarest examples of which adorn his library. It must be a matter of pride to all that so able and brilliant an article, marked with so many signs of care and research, appears in this country. It will, we think, be highly appreciated by our English friends.

Mr. F. L. Pope follows up his article in last month's *Scribner's Magazine* on the electric motor by one even better in this month's *Century*, on the American inventors of the telegraph, in which special reference is made to the services of Alfred Vail. From the evidence cited by Mr. Pope it is clear that the work of Mr. Vail, and the support given to the embryo telegraph by his family, have been too lightly passed over or not fully appreciated. The article is freely illustrated, containing portraits of Morse, Alfred Vail, Judge Stephen Vail, Professors Gale and Henry and the Hon. F. O. J. Smith, in addition to views, sketches and diagrams. It is a noteworthy contribution to the history of the telegraph.

MISCELLANEOUS NOTES.

The New York Subways.—The work on the New York subways, suspended by winter, is about to be resumed.

The Mutual Accumulator Company, of Jersey City, N. J., has been incorporated by R. Arnold and others, with a capital stock of $300,000.

Electric Programme Clocks.—The Reams Electric Programme Clock Company, of El Dorado, Kan., has been incorporated with a capital stock of $100,000.

Chetopa, Kan.—The Western Engineering and Electrical Company of Chetopa has been incorporated with a capital stock of $10,000, by L. Clark, E. W. Clark, E. Ruehel, R. B. White and E. D. Bates. The company will be general agents for Edison apparatus and will do construction work of all kinds.

The Page Belting Company have lately received a large order from Japan for a lot of their "Hercules rawhide" belting. Their prospects of trade in that country are very flattering. Within a week they have received inquiries for prices on their goods from St. Petersburg, Russia, and Alexandria, Egypt.

BUSINESS NOTICES.

Frames of every description for showcards and pictures can be had of William Levin, 37 Dey st. Quality and promptness guaranteed. Catalogue and estimates on application. A full line of elegant pictures low, for cash.

Hering's "Principles of Dynamoe Electric Machines."—"I have received 'Hering's Machines' all right, but have had time to only briefly look it over as yet. However, from what I have seen of it, I think it very good and just what I have wanted for some time. The tables in the back make it especially valuable as a reference book." S. K. DECHERD, Meriden, Conn.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolt cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

F. E. Pettingell & Co. have issued from their headquarters, 167 Congress and 161 Franklin streets, Boston, a handy little catalogue of the electric light, telephone and telegraph supplies that they handle as manufacturers, agents, importers and dealers. The firm have not been established very long, but they have built up already a large business and bid fair to do much better. Among the specialties they handle are Okonite, Phœnix Glass Company's goods, "Sunlight" carbons, Cleveland's switches and cut-outs, McIntire joints, Haynes' double pole switches, Cleveland motors, Jenney fittings, Kimball apparatus, etc., etc.

Hering's Book.—"I have read Mr. Hering's 'Principles of Dynamo-Electric Machines' My opinion is that it is pre-eminently fitted to fill the field of the wants between the electrician and the mechanic. His writings are clear and intelligible and his analogies are to the point, which to the beginner is his success. My assistant, Mr. Franz Rabl, joins me in its praise." CRAIG R. ARNOLD, Electrician Sawyer-Man Electric Co., Philadelphia, Pa.

Hine & Robertson, 45 Cortlandt street, N. Y., are pursuing a novel method of inducing electric light companies to try "Eureka" Packing. To every new customer ordering direct from them 15 pounds or more at regular price, 75 cents per pound, they will send a handsome 8-day calendar clock, 12 in. dial, 24 in. high, or set of brass oilers and tray, 6 pieces, best made. This is an easy way to secure one of these necessary articles and get a packing indorsed by the most prominent electric light plants.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED MARCH 27, 1888.

380,215. Ear Battery for the Deaf; Mary E. Moore, New York, N. Y. Application filed June 15, 1887. This is a zinc tube, wound with copper wire, with a small diaphragm at both ends. The device is to be inserted into the ear.

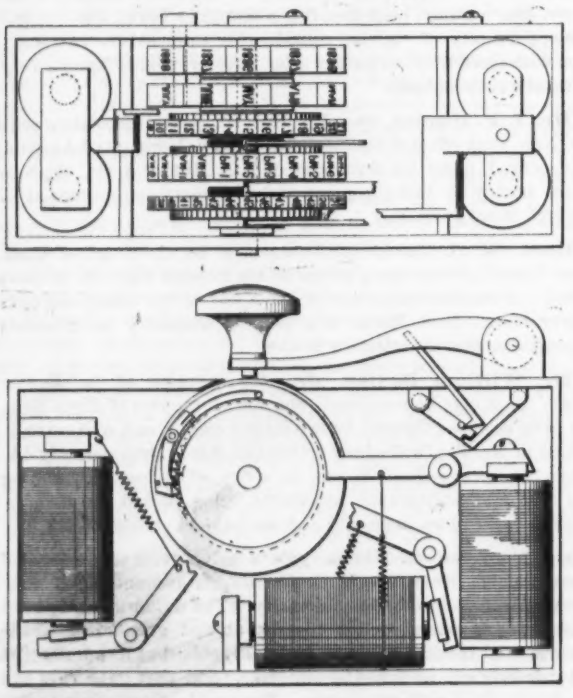
380,301. Electric Light and Globe Protector; William M. Tompkins, Batavia, N. Y. Application filed March 16, 1887. This is a lantern frame for protecting electric lights and globes.

379,960. Manufacture for Refractory Carbon; Chas. H. Land, Detroit, Mich. Application filed April 22, 1886. The carbon, located in an open muffle in an oven, is subjected to the products of combustion under pressure. A counter resistance is offered to expel oxygen from the muffle, preventing ignition of the matter.

PATENTS DATED APRIL 3, 1888

380,310. Telegraph Key; David Ray Borland, Montreal, Quebec, Canada. Application filed Feb. 24, 1887. Patented in Canada Feb. 17, 1887. An automatic switch lever rests normally over the finger button, and in removing it to manipulate the key the circuit is closed, while, as soon as the hand is removed from the button, it automatically cuts out the instrument.

380,316. Railway Signal; J. Hamilton Farrar, of Chicago, Ill. Application filed July 23, 1887. In a railway signalling apparatus, an electric circuit in which a section of the track is included, a rheotome included in the circuit, an armature carrying a signal disc, a spring drawing the armature away from the pole of the rheotome, and a lamp box having an opening over which the signal disc vibrates.



380,595. ELECTRIC TIME STAMP.

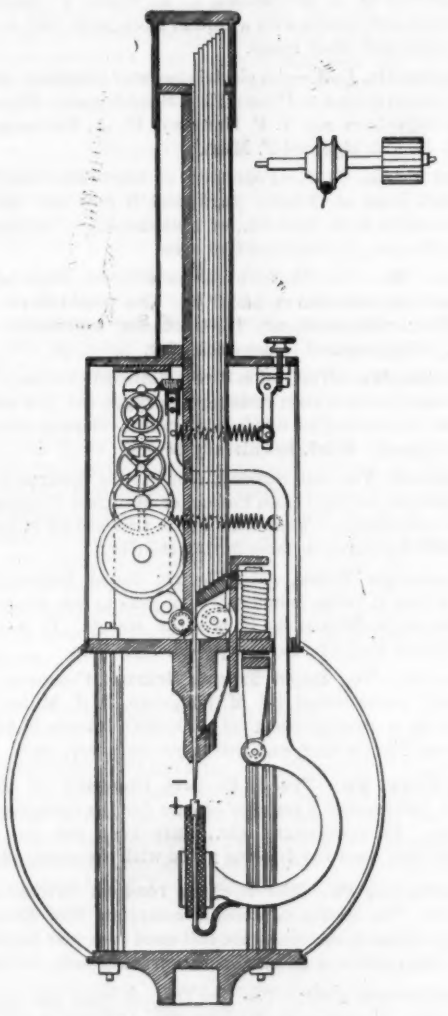
380,382. Electro-Magnetic Signaling Device for Mines; Logan McKnight Bullitt and Oscar C. Green, St. Paul, Minn. Application filed April 28, 1887. A trunk line runs through the main thoroughfare of the mine and branches are let off into the different galleries. The branches include batteries supplemental to the battery in main line.

380,394. Dust-Proof Thermostat; Abraham S. Kissell, Chicago, Ill. Application filed Sept. 14, 1887. The end of the bar carrying the contacts projects into a dust-proof box through an opening large enough to allow free movement of the bar. The opening is covered by a cap which moves with the bar, but always covers the opening.

380,430. Galvanic Cell; Wm. Frischmuth, Philadelphia, Pa., Assignor to Wm. H. Gaw, of same place. Application filed Jan. 26, 1887. The positive plate and all the screws and bolts are made of aluminium.

(1) 380,426. (2) 380,427. Telephone Transmitter; Moses G. Farmer, Elliot, Maine. Applications filed respectively April 14, 1888, and Sept. 14, 1877. These devices are similar to the Hunnings type of instrument, or those having comminuted carbon electrodes. The electrodes, however, are fixed, and have roughened surfaces in contact with the comminuted carbon, while the diaphragm rests against the carbon. The construction is such as to prevent packing of the powdered carbon. See illustration.

380,435. Electric Arc Lamp; August Harding, Oakland, California. Application filed April 23, 1887. The improvements consist in peculiarly constructed clutches fixed upon the shaft and acting in connection with friction gears loose



380,545. ARC LAMP.

thereon; in swinging brackets or hangers carrying pinions forming part of the chain of gearing and meshing with the ratchet faces of the carbon-rods, the brackets or hangers being separately and independently controlled to throw their pinions into and out of engagement by electro-magnets forming part of and peculiarly connected with the main circuit whereby one is brought in while the other is thrown out of the circuit, and in the means for dropping either rod by short circuiting said magnets when the arc becomes abnormally long.

(1) 380,437. (2) 380,438. Telephones; Warren D. House, Kansas City, Mo., Assignor to the House Improved Telephone Company, Philadelphia, Pa. Applications filed March 1, 1887. One electrode is a moving body of vibratory electrolytic material and the other is fixed and always in contact with it. In these constructions the movable body is in the form of a hollow wheel having its perimeter bearing against the diaphragm. The interior of the wheel carries the electrolytic liquid which keeps the body saturated. In another form the liquid is in a reservoir connecting with a diaphragm of absorbent material similar to the wheel.

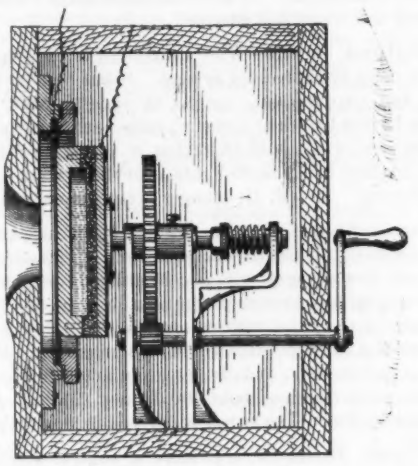
380,469. Underground Conduit for Electric Railways; S. Reca Whipple, Detroit, Mich. Application filed Aug. 19, 1887. The current is taken by a traveling truck from two rails in the conduit. The truck is in two parts insulated from each other and carries two gutters which catch and shed the water falling through the opening in the conduit.

380,545. Arc Lamp; Camille Berton, Paris, France. Application filed July 14, 1887. The lamps are of the type in which a carbon pencil is caused to abut against an infusible block; and one of the distinctive features of the invention is that the pressure of the carbon against this block is regulated automatically by the effect which the pressure itself exerts upon the feed mechanism. See illustration.

380,554. Secondary Battery; Nicholas De Benardos, St. Petersburg, Russia. Application filed Dec. 28, 1887. Each plate consists of a head frame, in which are strung or secured lead ribbons or strips alternately straight or plain or corrugated, attached individually by their ends to the frame. By alternating the flat strips with the corrugated strips the latter are well spaced, and no difficulty is experienced in preserving the openings to be entered by the battery liquid.

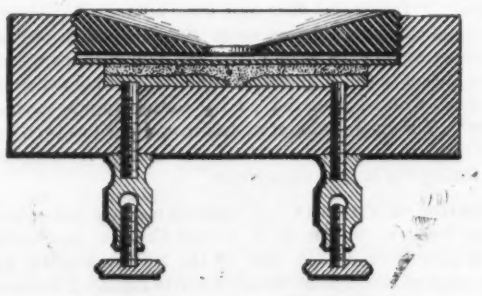
380,568. Electric Bell; Cornelius Bennett Harness, London, England. Application filed Dec. 18, 1883. Patented in England Oct. 13, 1883, No. 4,881. The belt has pockets carrying the battery cells. A rheotome and induction coil are connected with the battery and terminal electrodes are arranged for applying the current to the body.

380,589. Galvanic Battery; Charles Edward O'Keenan, St. Cloud, near Paris, France. Application filed June 2, 1887. A chamber is formed at one end of the battery trough in which is placed the acid crystals. The chamber is perforated at different heights to allow a circulation of the fluid through the chamber in order to maintain a constant degree of saturation.



380,438. TELEPHONE.

(1) 380,594. (2) 380,595. Electrical Time Stamps; Charles A. Randall, New York, N. Y. Applications filed, respectively, Aug. 19, 1886, and Sept. 7, 1886. The date, including the hour and minute, if desired, is changed automatically on the ordinary hand stamps by an electric current controlled by a clock. The clock closes the circuit at regular intervals, and a motor controlled by the current moves step by step and at the proper time rotates the printing wheels of the stamp to change the hour or day. See illustration.



380,426. TELEPHONE TRANSMITTER.

380,620. Dynamo-Electric Machine; Walter A. Crowdus and Henry M. Sutton, Dallas, Texas. Application filed Dec. 14, 1886. The armature consists of a flat ring formed of iron galvanized wire. The ring has projections or pole pieces formed of iron wire wound thereon, the whole being secured together by solder or other similar means.

(1) 380,646. (2) 380,647. (1) Electrical Signal Apparatus; (2) Electric Signal for RailwayCars; John Richard De Mier, Las Cruces, New Mexico, Assignor of both by mesne assignments to The De Mier Electric Train Signal Company. Applications filed June 9, 1887. Devices whereby signals may be sent to the engineer of a train. The invention consists of the details of the "pull" by which the circuit is closed.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.